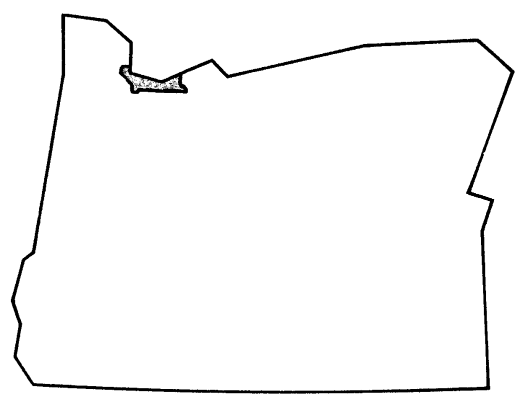
FLOOD INSURANCE STUDY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
FAIRVIEW, CITY OF	410180
GRESHAM, CITY OF	410181
*MAYWOOD PARK, CITY OF	410068
MULTNOMAH COUNTY UNINCORPORATED AREAS	410179
TROUTDALE, CITY OF	410184
*WOOD VILLAGE, CITY OF	410185

*Non-floodprone

December 18, 2009

Federal Emergency Management Agency

Flood Insurance Study Number
41051CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

Selected Flood Insurance Rate Map panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
B	X (shaded)
C	X (unshaded)

Part or all of this may be revised and republished at any time. In addition, part of this FIS may be revised by a Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS report components.

This FIS report was revised on December 18, 2009. User should refer to Section 10.0, Revision Descriptions, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS Effective Date: December 18, 2009

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PUBLISHED SEPARATELY

FLOOD INSURANCE STUDY
MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study revises and updates information on the existence and severity of flood hazards in the geographic area of Multnomah County, including the Cities of Fairview, Gresham and Troutdale, Oregon; and the unincorporated areas of Multnomah County (referred to collectively herein as Multnomah County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Portland is geographically located in Multnomah, Clackamas, and Washington Counties. The City of Portland is included in its own FIS report 410183V000A dated October 19th, 2004. The cities of Milwaukee and Lake Oswego are covered in the Clackamas County FIS report dated June 17, 2008. The Cities Maywood Park and Wood Village are non-floodprone.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the initial study of the City of Gresham were performed by the U.S. Army Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement Nos. IAA-H-16-75 and IAA-H-7-76, Project Order Nos. 16 and 1, respectively. This work, which was completed in June 1977, covered all significant flooding sources affecting the City of Gresham. Additional analyses for this study were performed by the USACE, Portland District, for Multnomah County, Oregon. Information on Fairview Creek was incorporated into this study.

The hydrologic and hydraulic analyses for the unincorporated areas were performed by the U.S. Army Corps of Engineers (USACE), Portland District, for FEMA, under Inter-Agency Agreement Nos. IAA-H-16-75, IAA-H-7-76, and IAA-H-10-77, Project Order Nos. 14, 1, and 23, respectively. This study was completed in July 1980.

Hydraulic analyses for Johnson Creek were revised in January 1983 by the USACE, Portland District, to reflect channel improvements between River Miles 6.8 to 7.3. Hydrologic analyses within Multnomah County Drainage District No. 1 were revised in a July 1984 report titled Multnomah Drainage District No. 1 Hydrology Study (Reference 1).

The hydrologic and hydraulic analyses for the City of Fairview were performed by the U.S. Army Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 21. This study was completed in May 1985.

The hydrologic and hydraulic analyses of Sandy River and the lower reach of Beaver Creek within the City of Troutdale were performed by U.S. Army Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-EMW-E-1153, Project Order No. 1, Amendment No. 21. The analyses for the two upper reaches of Beaver Creek were performed by the USACE for the Flood Insurance Study for the City of Gresham, Oregon (Reference 2). This study was completed in November 1985. Hydrologic and hydraulic analyses for Sandy River and Beaver Creek that were performed by the U.S. Soil Conservation Service (SCS) in October 1977 (Reference 3) were adjusted by the USACE to produce this study.

In 1985, additional USACE approximate analyses were added for Fairview Creek along the northern corporate limits of Gresham.

In 1988, the USACE revised the reach of Fairview Creek from a point located approximately 2,200 feet upstream of Barr Street upstream to NE. Glisan Street to incorporate changes made in topography and removal of culverts and to model a split flow that would occur on the upstream side of and east of NE Glisan Street.

In 1988, the USACE performed a revised study to upgrade the approximate analysis for Fairview Creek to a detailed study for the reach from approximately 1,000 feet downstream of Northeast Glisan Street to about 2,400 feet upstream of Southeast Division Street. The revised study was authorized under Inter-Agency Agreement No. EMW-E-2549, Project Order No. 9.

In 1995, the USACE revised the reach of Fairview Creek from Bridge Street to Fairview Lake. The hydraulic analysis was performed under Contract No. EMW-90-E-3286. The analysis supporting the revision was completed in June 1991.

In February 1996, the USACE revised a portion of Kelly Creek from the Mount Hood Community College (MHCC) dam upstream to Southeast Division Street. The revised analysis was performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-91-E-3529, Project Order No. 8A. The analysis supporting the revision was completed in June 1992.

The Beaver Creek study was revised on August 3, 1998 to add detailed flood information, including the adoption of a regulatory floodway, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street. The analyses supporting this revision were performed by the USACE, Portland District, for FEMA, under Contract No. EMW-94-E-4432, and was completed in April 1995.

The Kelly Creek study was revised on May 2, 2002 to show modifications to flood hazards along an approximate 3 mile reach from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street. The hydrologic and hydraulic analyses for the restudy were performed by Odgen Beeman and Associates, Inc., for the Federal Emergency Management Agency (FEMA), under contract No. EMS-96-CO-0078-TA05. This study was completed in September 1998. Water-surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data approved by the City of Gresham.

The countywide update was performed by WEST Consultants, Inc. for the Federal Emergency Management Agency (FEMA), under Contract No. EMS-2001-CO-0068 and was completed in August 2008.

1.3 Coordination

The dates of the initial and final CCO meetings held for the previous FIS reports for Multnomah County and the incorporated communities within its boundaries are shown in Table 1, "Initial and Final CCO Meetings". They were attended by representatives of FEMA, the communities, Soil Convation Service, Oregon Water Resources Board and the study contractor.

Table 1. Initial and Final CCO Meetings

Community	Initial CCO Date	Intermediate CCO Dates	Final CCO Dates
Fairview, City of	September 1982	May 28, 1985 July 14, 1988	September 3, 1986 April 19, 1990
Gresham, City of	March 5, 1975	July 14, 1988	July 13, 1978 December 14, 1989
Multnomah County, Unincorporated Areas	November 8, 1974	May 13, 1979	July 20, 1981
Troutdale, City of	September 1982	November 24, 1986	November 24, 1987

Countywide
An initial community coordination meeting for Multnomah County was held on December 14, 2005. This meeting was attended by representatives of the, cities and county, State of Oregon, FEMA and WEST Consultants. The results of the study were reviewed at the final Consultation Coordination Officer [CCO] meeting held on November 18, 2008, and attended by representatives of City of Fairview, City of Gresham, City of Troutdale, Multnomah County, FEMA, Department of Land Conservation and Development and West Consultants.. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the geographic area of Multnomah County, Oregon, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods in the City of Fairview, the City of Gresham, unincorporated Multnomah County, and the City of Troutdale were selected with priority given to all known flood hazards and areas of projected development or proposed construction through 1994, 1993, 1989, and 1990, respectively. Table 2 lists the streams studied in detail and the included segments.

Table 2. Detailed-Study Streams

Stream Name	Limits of Detailed Study
Beaver Creek	From confluence with Sandy River upstream to RM 3.3
Columbia River	From the Multnomah-Columbia County Limits to approximately RM 126.5
Fairview Creek	From its mouth upstream to RM 5.3
	Note: The reach of Fairview Creek from approximately 1,000 feet downstream of Northeast Glisan Street to approximately 2,400 feet upstream of Southeast Division Street, a distance of approximately 2.6 miles, was restudied by the Corps in 1988.
Fairview Creek – Right Bank Overflow Along NE Glisan Street	From upstream end of culvert at Glisan Street to its divergence from Fairview Creek
Fairview Creek – Left Bank Overflow Along Birdsdale Ave.	From upstream end of culvert under Portland Traction Railroad to its divergence from Fairview Creek
Johnson Creek	From the Multnomah-Clackamas County boundary near 82nd Avenue upstream to SE Pleasant Home Road
Kelly Creek	From Kane Road upstream to approximately 640 feet upstream of 282nd Ave
Multnomah Channel	From the Multnomah-Columbia County boundary to its divergence from the Willamette River
Ponding	Within Multnomah Drainage District No. 1
Sandy River	From its mouth to RM 6.17
Unnamed Tributary to Rock Creek	From the Multnomah - Washington County boundary near Germantown Road to a point approximately 0.5 miles east
Willamette River	From its mouth to the Multnomah-Clackamas County boundary

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA, Multnomah County and the incorporated communities listed in Section 1.1. Table 3 lists the streams and their included segments studied by approximate methods.

Table 3. Approximate-Study Streams

Stream Name	Limits of Approximate Study
Arata Creek	Between the downstream corporate limits at Marine Drive and the upstream corporate limits (western edge) west of Arata School and the Edgefield McMenamins' golf course
Beaver Creek	From Troutdale Corporate limits to approximately 1350 feet upstream from Division Drive culvert
Butler Creek	Individual areas in the following locations: upstream of SW 14th Drive, along SW Binford Lake Parkway, and within Butler Creek Park
Burlingame Creek	From its confluence with Kelly Creek to Country Club Estates Court
Columbia River	From the Limit of detailed study to the Multnomah-Hood River County Boundary
Fairview Creek Right Bank Overflow	From its confluence with Fairview Creek to NE Glisan Street
Kelley Creek	From the City of Portland Corporate limits to 190th Ave and from approximately 1000 feet downstream of NE Kane Road to NE Kane Road
Mitchell Creek	From its confluence with Kelley Creek to approximately 700 feet upstream of Baxter Road
Sandy River	From Dabney State Park to the Multnomah-Clackamas County boundary
Small drainage area upstream of Kaiser Road	From approximately 600 feet upstream of its confluence with Unnamed Tributary to Rock Creek to its mouth
Unnamed Tributary to Johnson Creek	From SW 14th Drive to approximately 580 feet upstream of SW 14th Drive
Unnamed Tributary to the East of Fairview Creek	From its confluence with Fairview Creek to approximately 670 feet upstream from NE Glisan Street.

2.2 Community Description

City of Fairview

Fairview is located along the southern banks of the Columbia River, 10 miles due east of downtown Portland, in northern-central Multnomah County, in northwestern Oregon.

Fairview is bordered by the City of Gresham to the south and west. To the east, Fairview is bordered by the Cities of Wood Village and Troutdale. The remainder of Fairview is bordered by unincorporated areas of Multnomah County.

Fairview was incorporated in 1908 and is primarily a residential community. Local employment is limited to shops and businesses that serve area residents. Employment for the majority of Fairview residents is elsewhere in the Portland metropolitan area (Reference 4).

The population of the city was 1,045 in 1970, 1,740 in 1983 and 1,975 in 1989 (Reference 5). As of 2000, the population number was 7,561 (Reference 6)

The climate of Fairview is characterized by mild, wet winters and dry, warm summers. The average annual precipitation for the area is 45 inches (Reference 7). Average temperatures range from 38°F in January to 68°F in July.

The surrounding area ranges from a busy metropolis west of the city to picturesque rural land to the south and east. The Columbia River lies to the north of the city. The area provides a wide choice of recreational opportunities, from fishing and backpacking to kite flying in the westerly winds that blow in from the Pacific Ocean.

Fairview Creek flows north from its source near Grants Butte, through Gresham and Fairview, and empties into Fairview Lake near the Columbia River. It drains rolling pastureland mixed with residential subdivisions. South of Fairview, Fairview Creek slopes gently as it passes through a thickly wooded area.

Multnomah County Drainage District No. 2 fronts the Columbia River approximately between 20th Avenue and Fairview Avenue. There is both agricultural and industrial development in its floodplain.

The Columbia River flows along the northern corporate limits of Gresham. Its flow is contained by the Multnomah Drainage District No. 1 levee. From its origin in Canada, the Columbia River flows over 1,100 miles to Fairview, while draining approximately 241,000 square miles of the western slope of the Continental Divide in the northwestern United States and southwestern Canada. The basin terrain varies from gently rolling farmland to high, timbered mountains.

City of Gresham

Gresham, a rapidly growing suburb of Portland, Oregon, is located to the east of Portland, along U.S. Highway 26 and Interstate Highway 84. It was incorporated in 1905. It is bordered on the northeast by the Cities of Fairview, Troutdale, and Wood Village. Gresham is bordered to the west by the City of Portland. Unincorporated areas of Multnomah County abut the remaining corporate limits of Gresham, except the southernmost point where it borders Clackamas County. Gresham is located in central Multnomah County, in northwestern Oregon, on the left bank of the Columbia River.

Gresham's population in 2000 was 90,205 (Reference 6) as compared to 63,845 in 1989 (Reference 8), 33,005 in 1980, 10,300 in 1970, and 3,944 in 1960 (Reference 9).

The City of Gresham is located on a low divide between Johnson Creek, the Sandy River, and the Columbia River. Johnson Creek, a tributary of the Willamette River, flows east to west through the southern portions of the urbanized area of Gresham. Beaver, Kelly, and Burlingame Creeks flow into the Sandy River to the east, draining the eastern portion of Gresham where substantial residential development has occurred. Fairview Creek, flowing northerly toward the Columbia River, drains the northern and central parts of Gresham. Butler Creek, a tributary of Johnson Creek, flows north draining the southwest section of Gresham.

The Columbia River flows along the northern corporate limits of Gresham. Its flow is contained by the Multnomah Drainage District No. 1 levee. Multnomah Drainage District No. 1 fronts the Columbia River along Marine Drive and Interlachen Lane. From its origin in Canada, the Columbia River flows more than 1,100 miles to Gresham, while draining approximately 241,000 square miles of the western slope of the Continental Divide in the northwestern United States and southwestern Canada. The basin terrain varies from gently rolling farmland to high, timbered mountains. Agricultural development exists along the floodplain within Gresham.

The major commercial development in the community has occurred along Powell Boulevard (U.S. Highway 26), with newer development occurring along Southeast Burnside Road. Residential development of various densities has occurred throughout the area. Land use along Johnson Creek is primarily residential.

The area consists of rolling benchlands and low hills. Vegetation varies from agricultural row crops and grain fields to the urban landscape associated with residential development; the steeper undeveloped terrain is covered with scattered fir and deciduous trees.

The soil of the study area is largely of the Powell silt loam variety, derived by the weathering of old, unconsolidated deposits of mixed origin. The soil has a rich brown, smooth-textured surface over afriable light-brown, gray-mottled subsoil. It is partly residual and partly transported in origin, with variable drainage rates (Reference 10).

The climate of Gresham is characterized by warm, dry summers and mild, wet winters. Temperatures are usually moderate, ranging from an average monthly minimum in January between 30°F and 35°F to an average summer maximum between 75°F and 80°F (Reference 11). The average annual precipitation is 45 inches with 80 percent occurring between October and March (Reference 12).

<u>City of Maywood Park</u>

The City of Maywood Park is located in north-central Multnomah County. Maywood Park is surrounded by the City of Portland. It was incorporated in 1967 and had an approximate population of 777 as of the 2000 Census (Reference 6). The approximate land area of the community is 0.9 square miles. The City of Maywood Park is currently identified as non-floodprone.

<u>Multnomah County</u>

Multnomah County is in northwestern Oregon. It is bounded by Columbia River on the north, by the Tualatin Mountains on the west, and by the Cascade Mountain Range on the east. Along the southern county boundary, Johnson Creek flows westerly to Willamette

River. Willamette River, as it flows northerly through Portland to join Columbia River, bisects western Multnomah County.

Multnomah County is bordered by Clark County, Washington, to the north, Skamania County, Washington, to the northeast, Hood River County to the east, Clackamas, County to the south, Washington County to the west, and Columbia County to the northwest. Encompassing nearly all of the Portland metropolitan area in its approximately 460 square miles, Multnomah County is the most populated and developed county in Oregon.

Since establishment of the county in 1854, its population has grown rapidly, from 338,241 in 1930 to 522,813 in 1960 (Reference 13). In 1978, the population was estimated at 549,000 (Reference 14). In 2006, the population was estimated at 681,454 (Reference 6). Most of that population resides in Portland and its adjacent communities within the Willamette Valley of western Multnomah County. Eastern Multnomah County is sparsely settled. Portland, the county seat and the largest city in Multnomah County, had an estimated 2006 population of 537,081 (Reference 6).

Columbia, Willamette, and Sandy Rivers are the largest rivers in Multnomah County. Columbia River, with its headwaters on the eastern slope of the Continental Divide in southwestern Canada, drains approximately 241,000 square miles. The basin terrain varies from steep mountain slopes to gently rolling farmland. Willamette and Sandy Rivers, with drainage areas of 11,200 and 502 squares miles, respectively, have their origin on the western slope of the Cascade Mountain Range. Willamette River originates in a steep, timbered, mountainous watershed and flows through the flat, wide, agricultural Willamette Valley for 185 miles to its mouth. Willamette River passes through Portland approximately 3 miles upstream of its confluence with Columbia River. Sandy River emerges from melting glaciers on Mount Hood, and then follows a steep and timbered valley until it meets Columbia River near Troutdale. Demand for recreated usage along the lower portion of the Sandy River is high. For example, Dabney and Lewis and Clark State Parks received 346,000 and 319,000 visitor days of use, respectively, in 1975 (Reference 3).

Flood plain development varies widely along Columbia River in the unincorporated portions of Multnomah County. Scenic Columbia River Gorge, upstream of Sandy River, is sparsely developed. From downstream of Sandy River to the Burlington Northern Railroad bridge, the south bank of the Columbia River has a broad flood plain protected by levee systems. Within those levee systems are agricultural lands, scattered industrial, commercial, and residential development. South of Columbia River, between the Burlington Northern Railroad and Willamette River, is Rivergate Industrial District, a recent development on dredged fill material that elevates previously low-lying land above expected flood levels. Farther downstream, Sauvie Island is bounded by Willamette River, Multnomah Channel, and Columbia River. The island is agricultural bottom land; most of the area is protected by levees.

The unincorporated portion of the Willamette River floodplain in Multnomah County extends upstream and downstream of the City of Portland. Flood plain development upstream of Portland is limited to residences along a narrow 2-mile-long strip on the west riverbank. The downstream portion is a 3-mile stretch, with the Sauvie Island perimeter levee on the west bank and the elevated Rivergate Industrial District on the east bank.

There are only a few homes and small businesses located along the riverbanks of Sandy

River immediately upstream of the Troutdale corporate limits. But, because of its nearness to the Portland metropolitan area, it has considerable development potential. Farther upstream, much of the river is within a forested canyon with moderately steep sides and a small flood-prone area. Downstream of the Troutdale corporate limits, there is no development within the flood plain.

Johnson Creek flows westerly for approximately 23 miles in southern Multnomah County and enters Willamette River at the county's southern boundary. The Johnson Creek flood plain is heavily developed in the study area between the corporate limits of Portland and Gresham. A wide flood-prone area extending from 100th Avenue to 136th Avenue and as far north of Johnson Creek as Holgate Boulevard includes many homes and some industries and warehouses. Upstream of Gresham, residences are scattered along the stream.

Columbia Slough enters Willamette River near its confluence with Columbia River in Portland. High-water levels in the slough and surrounding area are caused by Willamette River backwater. The detailed-study area within the unincorporated portions of Multnomah County is west of North Portland Road and almost entirely within the growing Rivergate Industrial District. Historically, the flood risk in that area has been too great to attract much development. Therefore, the bordering lowlands are still open for future land-use consideration.

Multnomah Cannel is a natural bypass channel for Willamette River to the Columbia River. The channel leaves the Willamette River approximately 3 miles upstream of the mouth of the Willamette River and travels northerly along the west side of Sauvie Island for approximately 20 miles to its confluence with the Columbia River. The portion of the Multnomah County within unincorporated Multnomah County has limited development.

Houseboats, several boat moorages, a marina, and a golf course are in the floodplain. Because of its proximity to Portland and major transportation routes, future floodplain development is probable.

Fairview Creek flows northerly from its source near Grants Butte, through the populated suburban area east of Portland, and empties into Fairview Lake near the Columbia River. It drains rolling pastureland interspersed with residential subdivisions. Fairview Creek has been channelized through a large subdivision between Burnside Road and Stark Street. South of the City of Fairview, the stream slopes gently as it passes through a thickly wooded area where a large planned-community development is under construction.

Beaver Creek, a tributary to Sandy River, flows northerly in a canyon with steep and forested side slopes. Because of the steep terrain, only a few areas are suitable for development within the Beaver Creek flood plain.

Kelley Creek enters Johnson Creek at 160th Avenue from low hills south of Johnson Creek. It drains an area of rolling farmlands with scattered residences. Mitchell Creek flows into Kelley Creek approximately 900 feet downstream of the Kelley Creek crossing of Foster Road.

The only stream studied west of Willamette River is Unnamed Tributary to Rock Creek, which is within the Tualatin River drainage basin. That stream flows from the steep and forested slopes of the low Tualatin Range and enters the flat pastured area of the study area south of Germantown Road. There is no development in the flood plain except for Kaiser Road. Just upstream of the Kaiser Road crossing, Unnamed Tributary to Rock Creek is joined by a small stream flowing southerly to its confluence.

Multnomah County Drainage District No. 1 fronts the Columbia River between approximately 20th Avenue and Fairview Avenue. There is both agricultural and industrial development in its flood plain.

Multnomah County has a temperate climate that is influenced by the Pacific Ocean, which is approximately 70 miles to the west. Summers are dry with pleasant temperatures; in the lower elevations, winters are rainy and mild with a narrow temperature range. Temperatures in Portland range from an average January minimum of 35°F to an average July maximum of 79°F (Reference 11). Near Willamette River, average annual precipitation is approximately 39 inches, with over one-half falling during the months of November through February. From Willamette River toward the east, average annual precipitation increases drastically. In the foothills of the Cascade Mountain Range, over 100 inches have been recorded (Reference 12). Soil drainage characteristics in the eastern portion of the county are generally good, while they are poor west of the Willamette River.

City of Troutdale

The City of Troutdale is located near the confluence of the Sandy and Columbia Rivers in Multnomah County, Oregon, approximately 15 miles east of Portland, at the mouth of the Columbia River Gorge, and 19 miles southeast of Vancouver, Washington.

Troutdale is also bordered to the west by the City of Gresham and to the north, southwest and southeast by unincorporated Multnomah County.

The city was founded in 1890 and incorporated in 1907. Troutdale's location at the western gateway of the Columbia River Gorge influenced its development as a river and railroad commerce center. Shipping, railroading and logging remained the primary commercial industries of Troutdale until the late 1940s. The economic character of Troutdale has changed dramatically since 1960.Troutdale is currently classified as a bedroom community in the greater Portland metropolitan area. As a result, its economic base is now very similar to the highly economic base of Portland. The three largest employers in the urban service area of Troutdale are the Portland-Troutdale Airport, the Reynolds School district, and Home Depot.

The population of Troutdale in the 1990 census was 7,852; in the 2000 census was 13,777; and as of July 1, 2007, the certified population for Troutdale is 15,430 (source: Portland State University Population Research Center certified population). Population increase has primarily been through construction of new housing on land previously farmed: 3,587 new dwelling units have been constructed in Troutdale since 1994.

The climate of Troutdale is characterized by mild, wet winters and dry, pleasant summers. However, due to its proximity to the Columbia River Gorge and the Cascade Mountains, winter wind speeds and precipitation are higher than in Portland. Troutdale averages 45 inches of yearly precipitation compared to 39 inches in Portland.

Sandy River, the third largest river in Multnomah County, drains an area of 502.3 square miles. Its origin is the Reed, Zigzag, and Palmer Glaciers on Mt. Hood. The Mt. Hood Wilderness Area, the Mt. Hood National Forest and the Bull Run Watershed Preserve comprise approximately 70 percent of the watershed area (Reference 3). Beaver Creek is a tributary of Sandy River and Drains an area of approximately 13 square miles.

Both the Sandy River and Beaver Creek are characterized by deeply entrenched river valleys. The elevation variation of the Sandy River Basin is 10 to 11,245 feet mean sea level (msl). The elevation range is 15 to 600 feet msl for the Beaver Creek Basin. The steep slopes of Beaver Creek preclude any significant development within its floodplain except in the lower one-half mile. A similar condition exists for all but the first six miles of the Sandy River.

Recreational usage along the lower portion of the Sandy River and Beaver Creek remains high. The City owns and maintains Glenn Otto Park, a 6.38 acre park with picnic areas, restroom, conference buildings and caretaker lodging. The park is located on the west bank of the Sandy River and the east bank of Beaver Creek. The entrance to the park is on the south side of East Historic Columbia River Highway just west of the Troutdale Bridge over the Sandy River.

A small City park (Depot Park) north of East Historic Columbia River Highway and south of the Union Pacific Railroad, has frontage on both banks of Beaver Creek at its confluence with the Sandy River.

The City also owns property fronting on the Sandy River north of the East Historic Columbia River Highway and south of I-84 that is proposed for mixed-use development including a riverfront promenade.

Arata Creek flows into Troutdale from Wood Village several times along their common boundary along the western edge of Troutdale. From Halsey Street upstream the drainage area is less than one square mile. At both the northwestern corporate limits and Marine Drive, where Arata Creek leaves the city for the final time, the drainage area is about 1.5 square miles.

City of Wood Village

The City of Wood Village is located in north-central Multnomah County. Wood Village is bounded by the City of Troutdale to the east, by the City of Gresham to the south, and by The City of Fairview to the west. It was incorporated in 1951 and had an approximate population of 2,860 as of the 2000 Census (Reference 6). The approximate land area of the community is 0.9 square miles. The City of Wood Village is currently identified as non-flood-prone.

2.3 Principal Flood Problems

Columbia River flooding in Multnomah County usually occurs in spring during the Columbia River Basin snowmelt freshet. However, intense winter rainstorms are the primary cause of flooding on the remaining Multnomah County streams, and they occasionally cause Columbia River flooding. Additionally, several localized ponding areas in the county are subject to flooding from seepage through levees during prolonged high Columbia River stages. Intense winter-storm runoff is the primary cause of flooding in the large ponding area along Johnson Creek.

The annual Columbia River snowmelt freshet occurs in May or June and has caused flooding in Portland during high-runoff years. The Willamette River floods during the spring freshet primarily as a result of backwater from the Columbia River. The June 1894, 1948, and 1956 floods, with recurrence intervals of 80, 48, and 18 years, respectively, were snowmelt freshets. Those flood events had peak discharges at The Dalles, Oregon, the nearest gaging station with a reliable discharge measurement of 1,240,000, 1,010,000 and 823,000 cubic feet per second (cfs), respectively.

Minor flooding in Multnomah County begins when flows at The Dalles reach 450,000 cfs, and major damage begins when flows reach 600,000 cfs.

Multnomah County flood damage from the June 1894 flood, the largest recorded on Columbia River, is not well documented. However, that flood is estimated to have covered the broad, flat area on the south bank of Columbia River from Sandy River to Willamette River below the elevation of approximately 36 feet. Additionally, on Sauvie Island and Hayden Island, only a few isolated knolls were above water. The Willamette River, backed up from the high Columbia River stage, caused damage primarily to development in the incorporated area of Portland.

The June 1948 flood, the second largest of record on Columbia River, resulted in Willamette River backwater that crested 12 feet above bankfull stage at the Morrison Street Bridge and inundated many riverside establishments. Multnomah County Drainage District No. 1 was flooded when the levee system failed. Flood depths in the drainage district ranged from 10 to 20 feet (Reference 15).

Damage in the unincorporated portion of the district included farm crops, farm buildings, and residences. Sandy Drainage District, which adjoins Multnomah Drainage District No. 1 on the east and extends to the Sandy River, was not flooded. However, the aluminum plant within the district suspended operations and provided approximately 600 people for flood fighting (Reference 16). Willamette River flooding downstream of Portland included the side of Oregon Shipbuilding Corporation, immediately downstream from Portland Terminal Four, and the lowlands that are now filled for Rivergate Industrial District. The area within Sauvie Island is divided roughly in half by two diking districts. The northern half, which contains the Columbia Diking District, was flooded. The floodwaters caused damage to farmland, residences, and farm structures. The southern half, protected by the Sauvie Island Drainage District, was nearly flooded. Sandbags were added to approximately 4 miles of levee crest to reinforce the levees, which were seeping heavily (Reference 17).

The December 1964 winter flood resulted from intense rainfall augmented by snowmelt. High concurrent discharges on both the Willamette and Columbia Rivers resulted in unusually high flood stages in Multnomah County. Along the Willamette River in the southern portion of the county, damage to residences was heavy. However, downstream of Portland, flood heights were less than in 1948, and damage to property fronting on the Columbia and Willamette Rivers and Multnomah Channel was limited to houseboats, boat moorages, and a lumber mill. A Hayden Island mobile home court was partially inundated, and adjacent areas of the island were flooded. Without reservoir control, the 1964 flood would have exceeded the 1894 and 1948 floods at the Morrison Street Bridge gage.

Flooding along the Sandy River can occur as a result of spring snowmelt runoff from the Mt.

Hood watershed. However, intense winter rainstorms are the primary cause of flooding. The Sandy River watershed has experienced many flood events. Recent significant floods occurred in December 1964, January 1956, and January 1972. These floods had recurrence intervals of 300, 10, and 30 years, respectively (Reference 18). Flows of 61,400, 23,900, and 36,200 cfs, respectively, were recorded at the U.S. Geological Survey (USGS) Sandy River near Marmot gage (No. 14137000). This gage was established in 1911, and measures data from a drainage area of 263 square miles (Reference 19). Because the floodplain was only lightly developed, damage in the unincorporated portions of the county was relatively minor. Most of the damage consisted of severe bank erosion, as most of the homes along the stream were above the flood levels. Downstream of the Troutdale corporate limits, Sandy River flood elevations are controlled by Columbia River stages.

The Johnson Creek Flood season extends from October through March. Streamflow records at the Sycamore gage, located 2 miles downstream from the Gresham corporate limits, show that flows have exceeded the major flood stage 10 or more times during the period of record commencing in 1940. Recent floods include January 1972 and December 1977, which had peak discharges of 2,190 and 2,230 cfs, respectively, and average recurrence intervals of approximately 10 years (Reference 20 and 21). Floods having average recurrence intervals larger than 10 years inundate the low-lying area between 100th Avenue and 122nd Avenue as far north as Harold Street. During a 100-year (1-percent-annual-chance) flood, this inundated area is expected to extend as far east as 140th Avenue and Holgate Street. The December 1964 flood had a peak discharge of 2,620 cfs and an average recurrence interval of approximately 15 years (Reference 22). Overbank flows occurred at Southeast Regner Road and continued downstream along the Portland Traction Company Railroad right-of-way. The largest area flooded included the Gresham City Park, where Johnson Creek makes a deep bend; the bend has since been bypassed by a short excavated channel. Downstream of Southwest Walters Avenue, flooding was confined between the Portland Traction Company Railroad right-of-way to the north and the slopes of Walters Hill to the south. Areas of sparse residential development and agricultural lands were flooded along Johnson Creek within the City of Gresham.

The main concern is the flooding of Fairview Creek in the downtown Fairview area. Most floods occur as a result of excessive rainfall from October to March. Snowmelt is usually an insignificant factor. Because Fairview is located at the lowest elevation in the Fairview Creek drainage basin, flood problems within the city will be influenced by any upstream development unless proper stormwater retention facilities are constructed.

Constrictions of Fairview Creek by partially plugged or undersized culverts at Southeast Burnside Road, at an unnamed road immediately upstream of the Tri-Met Lightrail bridge, at Southeast 202nd Avenue, and at the Portland Traction Company Railroad crossing upstream of Southeast 202nd Avenue have created backwater flooding over a wide area extending from Southeast Burnside to upstream of Northwest Division Street.

Flooding along Burlingame Creek have occurred frequently in the past and have been characterized by shallow overflows near the intersection of Hogan Place and Burnside Road.

Flooding along the Columbia River is caused in spring by the Columbia River Basin snowmelt freshet and in winter by intense rainstorms that result in high flows in the Columbia and Willamette Rivers. Flooding also occurs in more localized areas as a result of ponding from seepage through levees during prolonged high-river stages.

Past flood damage along the remaining streams studied is not well documented. Damage has been relatively low, however, because these streams are small and located in partially developed areas.

2.4 Flood Protection Measures

A significant flood elevation reduction of Columbia and Willamette Rivers, and Multnomah Channel, has been achieved through the use of flood-control storage reservoirs. There are 22 major reservoirs in the Columbia River Basin upstream of Multnomah County, with a total food-control storage volume of approximately 40 million acre-feet (Reference 23). There are 11 major flood-control reservoirs in the Willamette River Basin, with approximately 1.7 million acre-feet of flood storage. The stage-reduction effect of the Columbia and Willamette River flood-control storage reservoirs is shown in Table 4 (Reference 15).

The drainage districts along the Columbia River in the unincorporated portions of Multnomah County have levees of varying flood-protection capabilities. Thus, safe-water levels have been established by the USACE (Reference 24). The safe-water levels is the highest flood elevation, considering surveillance and minor remedial work, for which reasonable assurance can be given that a levee system will not fail. The criteria used to evaluate protection against the 1-percent-annual-chance flood are: (*1) adequate design, including freeboard; (2) structural stability; and (3) proper operation and maintenance*. Levees that do not protect against the 1-percent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance flood plain. Columbia Drainage District levees on the northern end of Sauvie Island would be overtopped by a 1-percent-annual-chance flood, whereas Sauvie Island Drainage District, Multnomah Drainage District No. 1, and Sandy Drainage District, with proper surveillance and maintenance, are expected to withstand the 0.2-percent-annual-chance flood event. However, these levees are currently certified for the 1-percent-annual-chance flood. Although the perimeter levee of a particular drainage district may be capable of withstanding large floods, major rainstorms could cause extensive interior ponding in low areas if runoff exceeds the capacity of the dewatering-drainage pumps.

There are no flood-control structures on Sandy River, Johnson Creek, Fairview Creek, Beaver Creek, Arata Creek or Unnamed Tributary to Rock Creek.

Another measure for providing flood protection from future floods is floodplain management. By restricting development in hazardous floodplain areas, flood related damage is prevented from occurring from all but the extremely large floods. Multnomah County has enacted floodplain management regulations. The regulations require that the county use existing flood plain information to determine whether new developments are reasonably safe from flooding. The regulations requires new developments to have first-floor elevations at least one foot above the 1-percent-annual-chance flood levels and discourages development within the floodway.

Elected officials of the tri-county Metropolitan Service District, formed in May 1978, have established a Johnson Creek Task Force representing the six counties and communities within that drainage basin. The task force has proposed storm water runoff management guidelines for adoption by the six political bodies. These guidelines apply to new development and are intended to control the rate of storm water runoff, thereby stemming

Table 4. Regulatory Effect of Flood-Control Reservoirs

Location	Flood Crest Elevation (Feet, NAVD88)			
	June 1894	June 1948	June 1956	December 1964
Vancouver Gage, Columbia River				
Observed	39.7	36.3	32.9	33.0
Unregulated	39.7	36.3	35.3	37.8
Regulated[1]	27.6	26.8	22.3	32.0
Portland Gage, Willamette River				
Observed	38.1	35.0	31.5	34.9
Unregulated	38.1	35.1	33.8	39.5
Regulated	26.0	25.2	20.7	34.0
Days Duration Above Flood Stage[2]				
Bankfull	74	51	70	9
Major Flood	38	26	12	2

[1]Based on present level of irrigation on reservoir development
[2]Flood or bankfull stage for Columbia River is 21.3 feet at the Vancouver gage.
A flood of 31.3 feet or higher results in extensive damage and is considered a major flood.
Vancouver gage vertical conversion to NAVD88 +3.46 ft, Portland gage vertical conversion to NAVD88 +3.48 ft.

the upward trend in flood damage. The task force is also considering a detailed drainage management plan, channel clearing and cleaning, and institution of an annual channel maintenance program.

Flood protection measures in the City of Fairview consist primarily of minor channelization. The National Weather Service in Portland, Oregon, is responsible for flood-warning and river-forecasting services in Multnomah County. General weather forecasts are also available. No flood-control structures have been built on Fairview Creek or on Unnamed Tributary east of Fairview Creek.

Nonstructural measures (a comprehensive land use plan, a zoning ordinance, and building permits) are being used to aid in the prevention of future flood damage in the City of Fairview. Zoning Ordinance No. 9-1974, enacted on November 10, 1974, follows Federal guidelines for controlling development within the 1-percent-annual-chance floodplain. The City of Fairview requires building permits, and it reviews those permits for compliance with the provisions of the zoning ordinance to ensure that sites are reasonably safe from flooding. The Comprehensive Land Use Plan was approved by the Oregon Land Conservation and Development Commission of July 10, 1980.

Storm runoff facilities are located throughout the City of Gresham urban area. A major diversion structure, built by the City of Gresham in 1976, diverts high flow through a 6-foot diameter underground pipe from Burlingame Creek to Kelly Creek. The intake facility is located on Southeast Burnside Road between Bull Run Road and Northeast Division Street and is designed to divert up to 200 cfs to Kelly Creek when flows in Burlingame Creek are greater than 100 cfs.

Gresham's comprehensive plan is used to limit development in the floodplain. It recommends areas of bordering streams as greenways and, within the greenway, only minimal new construction is allowed. In areas adjacent to those streams, the zoning ordinance, adopted as a prerequisite to participation in the NFIP, requires developers to furnish floodplain information to substantiate that proposed new development will not be subject to flooding.

The City of Troutdale has flood protection development standards. The most recent standards were adopted in the Troutdale Development Code November 24, 2000. The most significant standards include: balanced cut and fill within the 100-year floodplain; limitations of impervious area to not more than 30% of the 100-year floodplain; no new land division is permitted that would create a lot that is exclusively within the 100-year floodplain; residential construction is required to be elevated one foot above the Base Flood Elevation; and non-residential construction must either be elevated one foot above the BFE or dry-floodproofed.

The City requires that detention facilities be designed for the control of stormwater and floodwater runoff in accordance with the *Construction Standards for Public Works Facilities*.

The Sandy Drainage Improvement Company maintains drainage ditches and levees within the City of Troutdale for flood control north of I-84 to the Columbia and Sandy Rivers.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

The stage-discharge relationship for the Columbia River and Multnomah Channel near Multnomah County is influenced by ocean tides and by stages on the Willamette River. Similarly, the stage-discharge relationship of Willamette River in the study area is influenced by stages on the Columbia River. Thus, flood frequencies on both rivers and Multnomah Channel are more reliably determined for stages than for discharges. Combined stage-frequency curves were developed for seven locations on the Willamette River. Those locations include USGS gage No. 14144700 on Columbia River at Vancouver, Washington (Reference 25), and USGS gage No. 1421172 on Willamette River at the Morrison Street Bridge (Reference 26). Both gages were established in 1876. These curves were based on the statistical combination for stage-frequency curves for fall-winter floods and spring-summer floods.

Multnomah Channel discharges were estimated using the USACE HEC-2 step-backwater computer program (Reference 27). The HEC-2 computer model was calibrated to Columbia and Willamette River flood profiles, and Multnomah Channel discharges were derived by a trial-and-correction process.

Elevations for floods of the selected recurrence intervals on the Columbia River, the Willamette River, and Multnomah Channel are shown in Table 5.

The hydrologic analysis for Sandy River was performed by the SCS, Oregon State Office. The analysis used the standard log-Person Type III methods as outlined by the U.S. Water Resources Council (Reference 28). It was based on records for the Sandy River gage below Bull River, Oregon. That gage has a drainage area of 440 square miles and was in existence from 1929 to 1966. Flows computed at the gage were adjusted to compensate for the increase in drainage area downstream of the gage to the study area.

Discharges for the 1-percent-annual-chance flood were determined at several locations on

Discharges for Arata Creek and Unnamed Tributary to Fairview Creek were developed by the regional analysis presented in the U.S. Geological Survey Open-File Report 79-553, Magnitude and Frequency of Foods in Western Oregon (Reference 29). Those discharges were modified based on culvert capacity and overflow computations.

Stream gage records for Johnson Creek were statistically analyzed using the standard log-Pearson Type III distribution. A discharge-frequency curve (Reference 22) for the Johnson Creek stream gage at Sycamore was developed using records from 1941 to 1972. Peak discharges were adjusted downstream of the Sycamore gage to account for overbank storage in a large depression that extends from Interstate Highway 205 east to 140th Avenue and from Johnson Creek north to Holgate Street. The 10- and 2-percent-annual-chance discharges were reduced to compensate for flood storage available in that depression. The depression was considered to fill before peak 1- and 0.2-percent-annual-chance floodflows occur.

Discharges for Fairview Creek and Unnamed Tributary to Rock Creek were determined by correlations with available stream discharge-frequency relationships for similar watersheds. The discharges for Fairview Creek were correlated with Beaver Creek and Johnson Creek based on drainage area and slope on the discharge-frequency curves. The Unnamed Tributary to Rock Creek 1-percent-annual-chance discharges were computed using a USACE standardization procedure for ungaged streams (Reference 30). The discharge-frequency curve slope was correlated with an existing curve for Burnt Bridge Creek (Reference 31).

Flow estimates for the reach of Fairview Creek above River Mile 2.13 were developed by Kramer, Chin & Mayo, Inc. in Portland, Oregon, doing a drainage master plan on Fairview Creek for the City of Gresham. The method used was the U.S. Geological Survey (USGS) technique described in Open File Report 80-689, "Storm Runoff as Related to Urbanization in the Portland, Oregon – Vancouver, Washington Area" (Reference 32). Peaks were determined for each drainage area by placing a storm pattern on each one and computing the hydrograph. Then HEC-1 and HEC-2 models were used to route hydrographs and compute peak discharges along the creek. These peak discharges were larger than those developed by the USACE in January 1979 and used in the 1984 detailed study of 0.6 mile on Fairview Creek in Gresham and in the detailed study for the City of Fairview downstream of NE. Glisan Street. The newer discharges for the 1-percent-annual-chance flood were about 13 percent larger at NE. Glisan Street. The larger discharges developed for the drainage master plan were considered to be more accurate due to the more detailed analysis and therefore were used by the USACE for the restudy. Because split flow leaves the main channel of Fairview Creek at two locations, the discharges were reduced at Northeast Glisan Street and from the Portland Traction Company Railroad crossing downstream across Southeast 202nd Avenue to the private driveway crossing located approximately 1,500 feet upstream of Burnside Road.

Flow estimates for Kelly Creek were developed by the USACE using the HEC-1 computer program (Reference 33). The input parameters were estimated based on correlation with a study done by URS Corporation of Kelly Creek in 1988, and a Master Drainage Plan Report done by KCM, Inc., in 1988 for Fairview Creek, which is just west of Kelly Creek basin in Gresham (Reference 34).

Kelly Creek discharges used for the May 2, 2002 restudy were taken from a previous study of Kelly Creek, based on HEC-1 modeling, performed by the USACE (Reference 35). The reach of the previous study extended from the downstream crossing of Kane Road, near Mount Hood Community College, upstream to NE Division Street. The discharge values in this reach were compared with the U.S. Geological Survey (USGS) regression equations to verify their accuracy. They were then adjusted by a drainage area ratio at seven locations on the restudy reach. The peak discharges used in this restudy for the 10-, 2-, and 1-, and 0.2-percent-annual-chance floods are shown in Table 6, “Summary of Discharges”.

Flow estimates for the 1-percent-annual-chance flood on Beaver Creek were correlated with flow records of the Sandy River stream gage, located 2 miles northwest of the community of Bull Run. The data were based on reading from 1910 to 1914 and from 1929 to the present. However, flood recurrence interval relationships for the 10-, 2-, and 0.2-percent-annual-chance flows were based on the data from the Johnson Creek gage near Sycamore.

Peak discharge-drainage area relationships for Sandy River, Arata Creek, Unnamed Tributary Fairview Creek, Johnson Creek, Fairview Creek, Unnamed Tributary to Rock Creek, and Beaver Creek are shown in Table 6.

The rate and volume of runoff for the 1-percent-annual-chance flood within Multnomah County Drainage District No. 1 were determined using the Environmental Protection Agency Stormwater Management Model (Reference 36). The model calculates the rate of runoff at specific time intervals throughout the storm based on characteristics of rainfall and the physical characteristics of the drainage basin. The computed runoff draining into Columbia Slough was then balanced against the ability of the drainage district pumps to discharge water from the slough. The volume of runoff draining to the slough that exceeded district pumping capabilities was calculated at specific time intervals throughout the storm. The peak water-surface elevation for the 1-percent-annual-chance storm was then determined using the volume of storage at various elevations in the slough (Reference 1).

Discharges used for approximate-study stream lengths were derived by correlations with similar drainage basins and based on a comparison of drainage areas.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Water-surface elevations were computed through the use of the USACE HEC-2 step-backwater program (Reference 27).

Columbia River flood profiles for specific recurrence intervals were plotted directly from the combined stage-frequency curves described in Section 3.1. The HEC-2 computer program was calibrated to the plotted 1-percent-annual-chance flood profile and used for the Columbia River floodway determination. Discharges used in the floodway computations were correlated, based on data at USGS gage No. 14105700 (established in 1857) at The

Table 5. Summary of Elevations

Flooding Sources and Location	Drainage Area (Square Miles)	Elevation (Feet, NAVD 88) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Columbia River At Vancouver, Washington (River Mile 106.5)	241,000	25.8	29.9	31.6	35.2
Willamette River At Morrison Street Bridge (River Mile 12.8)	11,200	25.5	30.2	32.3	37.2
Multnomah Channel At Sauvie Island Bridge	--[1]	25.1	29.2	30.8	34.9

[1]Not Applicable
Vancouver gage vertical conversion to NAVD88 +3.46 ft.
Portland gage vertical conversion to NAVD88 +3.48 ft.
Multnomah Channel vertical conversion to NAVD88 +3.39 ft.

Dalles, Oregon (Reference 37), to yield water-surface elevations similar to the combined stage-frequency curves.

Willamette River flood profiles are referenced to combined frequency computations for the Morrison Street Bridge gage. A HEC-2 computer model was used to estimate flood elevations upstream and downstream of the gage. Discharges used in the HEC-2 model were correlated, based on data at USGS gage No. 1419100 (established in 1892) at Salem, OR (Reference 37), to yield water-surface elevations similar to the combined stage-frequency curves.

The HEC-2 program was used to prepare Multnomah Channel flood profiles that connect corresponding Columbia and Willamette River combined frequency flood profiles downstream and upstream of the study reach.

Flood profiles for Sandy River were originally computed by the SCS. The analysis used the SCS Water Surface Profile Computer Program (WSP2) to compute flood stages at each cross section. The profiles were prepared by SCS for a 1977 report (Reference 38). Hydraulic analyses performed by the SCS, were regenerated using the USACE's HEC-2 program (Reference 27). The WSP2 program used elevation-discharge-velocity information to plot rating curves for each cross section. The rating curves were used with peak flow-frequency information from the hydrologic studies and with historic high water information to obtain water-surface elevations for the 10-, 2-, and 1-percent-annual-chance floods at each cross section. Some adjustments in the computed water-surface elevations (CWSEL) occurred as a result of conversion from the WSP2 to the HEC-2 program. Primarily, CWSELs were lowered in the vicinity upstream of the bridges. In the beginning downstream reach, the 0.2-percent-annual-chance flood CWSEL was higher in the HEC-2 data due to a different starting technique. The SCS used the same starting water-surface elevation (SWSEL) for both the 1- and 0.2-percent-annual-chance floods (elevation of December 1964 flood) while the USACE used the slope-area method. However, both the WSP2 and the HEC-2 0.2-percent-annual-chance flood SWSEL were submerged by the backwater from the Columbia River combined probability flood profiles up to the I-84 bridges.
Johnson Creek Flood profiles were computed using the HEC-2 step-backwater computer program, with the exception of the stream length between Telford Road and U.S. Highway 26. There are three complex bridges in that area that could not be modeled reliably by computer; thus, manual computations were made.

Fairview Creek flood profiles were also computed using the HEC-2 step-backwater program with the exception of the area near the Stark Street culvert. Manual calculations were used to determine the hydraulic losses through this culvert.

The Fairview Creek study was revised on July 3, 1995, to add base flood elevations, and to update the flood boundary delineations from Bridge Street to Fairview Lake. The hydraulic analysis conducted for this restudy utilized the HEC-2 step-backwater program. Cross-sectional data were obtained from the field surveys performed in May 1991, and were supplemented with topographic maps provided by Multnomah County. The 1-percent-annual-chance flood elevation calculated at the farm road crossing, which acts as a weir, at the outlet of Fairview Lake was used as the starting-water surface elevation. The revised floodway was established using equal conveyance. The results are shown on Table 8.

Table 6. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Sandy River					
At mouth	502	48,000	72,000	82,800	129,200
At Dabney Park	483	46,500	69,700	80,100	125,000
Johnson Creek					
At 82nd Avenue	46	2,450	4,050	5,400	7,700
At USGS gage	28	2,350	3,700	4,350	6,200
At Southeast 174th Avenue	21	18,404	2,870	3,400	4,930
At Southeast 252nd Avenue	7	870	1,370	1,630	2,350
Fairview Creek					
At mouth	5.2	280	420	490	640
At Sandy Boulevard	4.5	260	370	430	560
At Banfield Expressway	4.4	185	295	350	505
At NE Halsey Street	4.3	180	290	345	495
Downstream of NE Glisan Street	3.08	108[1]	129[1]	137[1]	152[1]
Upstream of NE Glisan Street	3.08	190	270	300	390
At Southeast Burnside Road	1.9	85	135	160	230
Unnamed Tributary to Rock Creek					
At Kaiser Road	3.2	160	240	260	340

[1]Flows reduced due to overland flow to the east along NE. Glisan Street

Table 6. Summary of Discharges (continued)

		Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (Square Miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Columbia River below Gresham, Oregon					
At Vancouver, Washington (River Mile 106.5)	241,000	22.3	26.4	28.1	31.7
Beaver Creek					
At Crown Point Road	13	1,200	1,800	2,100	3,300
At SE Stark Street	11.7	551	871	1,038	1,485
At Kelly Creek	6.6	329	520	620	887

Due to limitations of map scale and the use of established river miles, stream distances as depicted on the flood profiles may not always match those depicted on the maps.

The HEC-2 analysis of Unnamed Tributary to Rock Creek had to compensate for sheet flow losses. During floods, the stream overtops its north bank and flows westerly across the county boundary. Flows were reduced in the computer model to account for these losses.

Columbia and Willamette River cross sections were based on USACE condition surveys, dated 1974 and 1976, and topographic maps (Reference 39 through 45). Multnomah Channel cross sections were measured by hydrographic survey methods. Cross sections for Sandy River, Johnson Creek, Fairview Creek, and Unnamed Tributary to Rock Creek were field measured. Overbank topography for Multnomah Channel was defined by USGS topographic maps (Reference 40). Cross sections on Johnson and Fairview Creeks were supplemented with information from topographic maps (Reference 41 and 42). Bridge drawings for structures on Columbia and Willamette Rivers were provided by government agencies and private industry. Bridge information for structures on Sandy River, Johnson Creek, and Fairview Creek was obtained by field measurement.

Roughness values (Manning's "n") used in detailed hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. The acceptability of all assumed hydraulic factors, cross sections, and hydraulic structure date was check by computations that duplicated historical flood profiles (Reference 46). Surveyed highwater marks for the Sandy River and Beaver Creek were used to calibrate the computer model and determine the accuracy of the friction factor chosen. Where the computed elevation did not adequately reflect the actual experiences, the chosen factor was adjusted. Ranges of values for streams are summarized in Table 7.

Table 7. Roughness Coefficients

	Roughness Coefficients	
Stream	Channel	Overbank
Columbia River	0.025-0.038	0.050-0.100
Willamette River	0.030-0.050	0.050-0.100
Multnomah Channel	0.030	0.050-0.100
Johnson Creek	0.030-0.045	0.050-0.100
Kelly Creek	0.035-0.040	0.038-0.080
Sandy River	0.025-0.050	0.050-0.100
Fairview Creek	0.035-0.095	0.050-0.150
Unnamed Tributary to Rock Creek	0.015-0.080	0.050-0.100
Beaver Creek	0.035-0.050	0.060-0.070

The starting water-surface elevations for Columbia River flood profiles were based on the appropriate combined stage-frequency curve, while Willamette River and Multnomah Channel starting elevations were on coinciding Columbia River flood elevations.

The starting water surface elevations for the Sandy River were based on a slope-area method with a starting slope of approximately 0.00029 to 0.00025. There is overflow from Sandy River and interflow with Beaver Creek from Crown Point Highway downstream to their confluence, and Beaver Creek computed water surface elevations reflect the increase in the discharge because it was assumed that the two streams will peak together. A split-flow analysis was made to determine the quantity of overflow into Beaver Creek for the 2- and 1-percent-annual-chance floods. The 0.2-percent-annual-chance flow was so great that the cross sections were extended to include Beaver Creek in the Sandy River floodplain.

Backwater from Columbia River controls flood crests in the reach of the Sandy River downstream of I-84 bridges for the 1- and 0.2-percent-annual-chance floods and for the reach downstream of the UPRR trestle for the 10- and 2-percent-annual-chance floods.

Johnson Creek starting elevations were obtained from the Flood Insurance Study for the City of Portland (Reference 47). Previous flood elevations, channel slopes, and bank elevations were considered when the starting water-surface elevations were determined for Sandy River, and Unnamed Tributary to Rock Creek.

Starting water-surface elevations for Fairview Creek were based on normal-depth calculations. Starting water-surface elevations for the reach being revised, from River Mile 2.13 upstream to NE. Gilsan Street, were obtained by using the computed energy grade slope at cross section 2.13 from the last Flood Insurance Study for Fairview, Oregon, dated September 30, 1987 (Reference 48).

Water-surface elevations within Multnomah County Drainage District No. 1 are based on a July 1984 hydrology study for the district (Reference 1). As a result of this study, the 100-year water-surface elevation within the district was reduced from 17 feet to 14 feet (NGVD 29).

A detailed hydrologic and hydraulic analysis of Kelly Creek was completed in June 1992 and became effective on February 16, 1996. The detailed study was performed for Kelly Creek from the Mount Hood Community College (MHCC) dam, located approximately 1,100 feet downstream of Northeast Kane Road, upstream to Southeast Division Street, a distance of approximately 0.8 miles.

The hydraulic analysis for the revised study was performed using the USACE HEC-2 step-backwater computer program (Reference 27). Data for the cross section, including overbank areas, were taken from topographic maps at a scale of 1”=100’, with a contour interval of 2 feet (Reference 49). Data at the Kane Road culvert and MHCC outlet structure were surveyed in past years and verified by a field visit in March 1992.

Channel and overbank roughness coefficients (Manning’s “n”) used in the computer program were estimated from experience and field observations. A value of 0.035 was used for the channel and values ranged from 0.038 to 0.042 for the overbank areas. The starting water-surface elevation was obtained from a rating curve computed at the upstream end of the culvert at Kane Road. The hydraulic study included the backwater effect from the MHCC dam on the culvert outlet at Kane Road.

The floodway was computed using Method 4 of the HEC-2 computer model from Kane Road to approximately 522 feet upstream. Method 6, with a 1.0-foot allowable rise in the energy grade line, was used from this point to approximately 3,161 feet upstream. Method 6, with a 0.1-foot allowable rise in the energy grade line, was used from this point to the limit of detailed study at Division Street.

The floodway and 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps. In cases where the lines are collinear, only the floodway boundary has been shown.

Table 6, “Summary of Discharges,” Table 8 “Floodway Data,” and the Profile Panels were also revised to reflect the results of this detailed study.

The Kelly Creek study was revised on May 2, 2002 to show modifications to flood hazards along an approximate 3 mile reach from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street. Water-surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data approved by the City of Gresham.

The hydraulic analysis for Kelly Creek was performed using the HEC-RAS step-backwater computer program, Version 2.1 (Reference 50), to provide the water-surface elevations along the study reach. The starting water-surface elevation was taken from the results of the previous hydraulic study performed by the USACE (Reference 35), directly downstream of the restudy reach. The model was run in a sub-critical flow regime to estimate the flood profiles.

Cross section locations were chosen based on field investigations and USGS quadrangle maps (Reference 40). Chase, Jones & Associates, Inc. (Reference 51) surveyed fourteen cross sections in the restudy reach. Other cross sections were taken from the City of Gresham’s 1”=200’, two foot contour interval, topographic maps (Reference 52). The first three downstream cross sections were repeated from the previous study completed on Kelly Creek, directly downstream of the restudy reach (Reference 35). All of the culverts, roads, detention facilities, and bridges were surveyed by Chase Jones and Associates, Inc. (Reference 51).

Manning’s “n” values chosen varied from 0.06 to 0.08 for the left and right overbanks and 0.04 for the channel, based on field observations. The Manning’s “n” values were repeated for the cross sections duplicated from the downstream study.

The floodway corresponding to the 1-percent-annual-chance flood was initially determined using method 4 encroachment analysis in HEC-RAS (Reference 50), with a water-surface rise of one foot. The method 4 approach was then converted to method 1 and modified to ensure the floodway did not encroach inside the channel banks.

The Beaver Creek study was revised on August 3, 1998 to add detailed flood information, including the adoption of a regulatory floodway, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street.

Flooding along Beaver Creek occurs from two sources. Overflow from Sandy River creates a backwater effect along Beaver Creek from its confluence point with the Sandy River to approximately 6,200 feet upstream. Flooding along the remainder of Beaver Creek is due only to flow originating from the Beaver Creek watershed. Because of the backwater effects from the Sandy River, the lower portion of Beaver Creek is a level pool with essentially constant elevations. From approximately 6,200 feet upstream, the steep slope of the basin results in supercritical flow.

The hydrologic analyses for this portion of Beaver Creek were obtained from the FIS report for the City of Troutdale (Reference 53). This analysis was performed by the National Resources Conservation Service (formerly the SCS), Oregon State Office. Streamflow data at gaging stations in the Sandy River basin were processed in accordance with the method described by the Water Resources Council (Reference 54). A regional analysis of the peak flow-frequency characteristics as a function of the drainage area was made and used to determine the unit peak discharge-frequency for Beaver Creek as shown in Table 6. The discharge at Troutdale Road was obtained by prorating the discharge at Southeast Stark Street to account for the reduction in drainage area.

The hydraulic analysis of Beaver Creek was performed using the USACE HEC-2 step-backwater program (Reference 55). Starting water-surface elevations just upstream of Jackson Park Road were taken from the previous published FIS. Cross-section information was developed from topographic work maps at a scale of 1"=100', with a contour interval of 2 feet (Reference 56). Roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment and field observations of the channel and overbank areas. Manning's "n" values of 0.04 and 0.07 were chosen for the channel and overbanks, respectively.

The floodway along the studied portion of Beaver Creek was computed on the basis of equal conveyance reduction from each side of the floodplain. From just upstream of Jackson Park Road to approximately 3,100 feet upstream, and from Troutdale Road to Southeast Stark Street, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the water surface. From 3,100 feet upstream of Jackson Park Road to Troutdale Road, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the energy gradeline.

The approximate analysis on Columbia River upstream of the Sandy River was based on existing 1-percent-annual-chance profiles (Reference 57) and existing topographic maps (Reference 39). Sandy River approximate analysis included field investigations to recover the 1964 high-water marks and normal-depth calculations to define the flood plain, using available topographic information (References 41 and 58).

Kelly, Beaver, and Fairview Creek approximate analyses were completed based on existing topographic information (Reference 41) and normal-depth calculations.

Burlingame, Kelley, and Butler Creeks and Unnamed Tributary to Johnson Creek approximate elevations were derived from field analysis and using 2-foot contour interval maps (Reference 41).

The approximate analysis on Arata Creek was based upon existing topographic maps (Reference 56), culvert analyses, and normal depth computations.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

The hydraulic analyses for this study were based on unobstructed flow, except for the culverts at Birdsdale Avenue and the Tri-Met Lightrail, which were modeled as found, half-filled with sediment. The culvert at Division Street, which was submerged and assumed mostly filled with sediment during surveys in 1985, was modeled as being open because it was reported as being cleaned out in 1987. The flood elevations shown on the profiles are thus considered valid for these conditions (with noted exceptions) only if hydraulic structures remain unobstructed, operate properly, and do not fail.

3.3 Vertical Datum

All FIS reports and FIRMS are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRMs are referenced to NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD and the NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

The conversion factor from NGVD to NAVD for all streams in this report is +3.43 feet.

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description and/or location information for benchmarks shown on the FIRMs, please contact information services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and 1-perent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS, including

Flood Profiles, Floodway Data tables and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:1,200 and 1:2,400, with a contour interval of 2 feet and 1:24,000, with contour intervals of 10 and 20 feet (References 39 through 45 and 56).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, and AO), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the revised Kelly Creek study of May 2, 2002 the City of Gresham provided two-foot contour interval topographic maps (Reference 52), based on aerial photography from 1990. These maps were used as the base map and to delineate the floodplain based on the flood profiles.

The 1998 restudy of Beaver Creek resulted in a redelineation of the base floodplain and the flood boundaries associated with a flood having a 0.2-percent chance of being equaled or exceeded in any given year on topographic maps at a scale of 1”=100’, with a contour interval of 2 feet (Reference 56). The flood profiles for Beaver Creek were based on elevations obtained from the HEC-2 model. In the portion of Beaver Creek where supercritical flow occurs, critical depth elevations were plotted on the profile.

For streams studied by approximate methods, the boundaries of the 1-percent-annual-chance floodplain were delineated on the aforementioned topographic maps in conjunction with previously estimated elevations.

Boundaries for the shallow flooding areas were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Reference 41), in conjunction with the previously estimated elevations.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

Base map aerial imagery shown on this FIRM is from the Metro Data Resource Center and was collected during July 2004. Non-revised floodplains were compared to this new base map data and adjusted where appropriate.

In accordance with FEMA Procedure Memo 36 (Reference 17), profile base lines have been included in all areas of detailed study. Profile base lines are shown in the location of the original stream centerline or original profile base line without regard to the adjusted floodplain position on the new base map. This was done to maintain the relationship of distances between cross sections along the profile base line between the hydraulic models, profiles and floodway data tables.

Countywide Update

As part of the countywide update, floodplain boundaries within the City of Fairview for portions of the Columbia River, Fairview Lake, Blue Lake, and Fairview Creek were revised based on topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Reference 59). Additionally, portions of the Columbia River, Sandy River, Willamette River, and Multnomah Channel were revised based on 2 foot contour interval topographic data developed from LiDAR data created by the Puget Sound LiDAR Consortium (Reference 60). The data can be used at a horizontal scale of 1:12,000 (1 inch=1,000 feet) or smaller.

The floodplain boundaries for the remaining streams were digitized from the effective FIRM and Floodway panels. Aerial photography (Reference 61) was used to adjust floodplain and floodway boundaries where appropriate.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 8). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Portions of the floodways of Columbia River, Willamette River, and Johnson Creek are outside of the unincorporated areas of Multnomah County.

No floodway is delineated for Sandy River downstream of the Union Pacific Railroad bridge due to the low development potential of that area. No floodway is delineated upstream of Clark Road on Johnson Creek due to the steep stream gradient in that area. Both of these decisions were agreed upon by the study contractor and FEMA.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

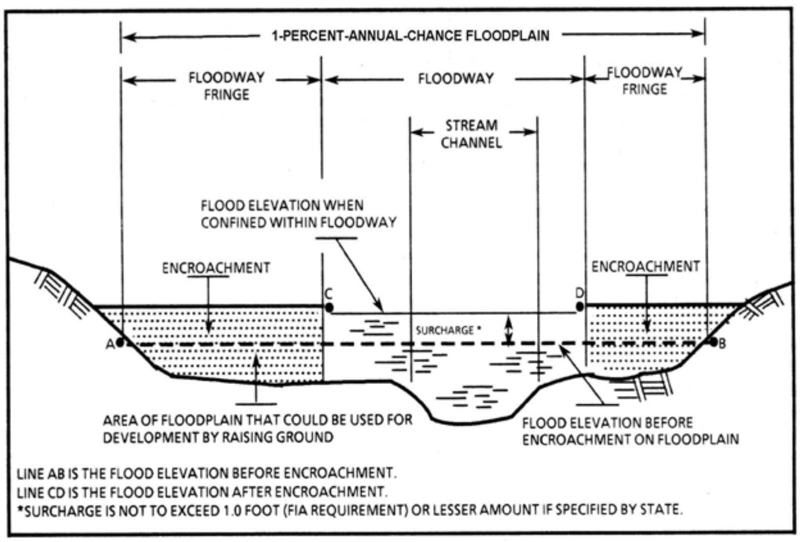

Figure 1. Floodway Schematic

<u>Countywide Update</u>

The floodway width at cross section F on the Sandy River was revised as part of the countywide update where new topography resulted in a mapped 1-percent annual chance floodplain that was narrower than the effective floodway. The floodway was mapped as coincident with the 1-percent annual chance floodplain.

In accordance with FEMA Guidelines and Specifications for Flood Hazard Mapping Partners (Reference 62), floodways which abut certified levees are to be mapped to the landward toe of the levee. Several locations where the effective mapping did not reflect this were revised and the floodway boundary was moved to the landward toe as determined by new topographic data (References 59 and 60). This was done for the Columbia River at cross sections C, D, and Q and for the Multnomah Channel at cross sections D and E. Floodway widths shown in Table 8 were updated to reflect the revised floodway boundary.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Beaver Creek								
A	633	150	2,080	2.3	38.0	38.0	38.5	0.5
B	1,373	150	2,000	2.4	39.3	39.3	39.6	0.3
C	1,848	128	1,720	2.6	39.5	39.5	39.7	0.2
D	2,006	44	690	6.8	39.5	39.5	39.7	0.2
E	2,270	115	1,130	1.8	42.9	42.9	43.2	0.3
F	2,798	110	2,050	1.0	43.0	43.0	43.2	0.2
G	3,115	23	485	4.1	43.1	43.1	44.1	1.0
H	3,500	101	1,042	1.4	43.4	43.4	44.4	1.0
I	6,350	42	173	11.6	47.1	47.1	47.5	0.4
J	8,150	40	170	11.8	114.6	114.6	114.6	0.0
K	9,350	40	170	11.7	157.5	157.5	157.7	0.2
L	10,530	40	316	3.4	186.9	186.9	186.9	0.0
M	12,290	39	148	7.0	198.2	198.2	198.4	0.2
N	12,778	10	133	7.8	214.1	214.1	215.1	1.0
O	12,988	136	1,520	0.7	215.4	215.4	216.2	0.8
P	13,593	152	955	1.09	215.5	215.5	216.2	0.7
Q	13,886	40	167	6.21	215.6	215.6	216.3	0.7
R	14,362	40	142	7.31	219.9	219.9	220.8	0.9
S	14,679	70	206	5.04	223.5	223.5	224.1	0.6
T	14,995	80	140	7.41	228.9	228.9	228.9	0.0
U	15,523	47	207	5.01	233.3	233.3	234.1	0.8
V	15,787	40	163	3.80	234.2	234.2	235.2	1.0
W	16,421	40	119	5.21	237.3	237.3	238.2	0.9
X	16,843	35	143	4.43	240.2	240.2	240.9	0.7

[1] Feet above mouth

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

BEAVER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Beaver Creek (continued)								
Y	16,896	17	59	10.51	241.1	241.1	241.1	0.0
Z	16,949	50	285	2.17	243.1	243.1	243.1	0.0
AA	17,160	29	95	6.52	243.2	243.2	243.2	0.0
AB	17,477	40	167	6.2	246.0	246.0	246.4	0.4

[1] Feet above mouth

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

BEAVER CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY[3] (FEET NAVD)	WITHOUT FLOODWAY[4] (FEET NAVD)	WITH FLOODWAY[4] (FEET NAVD)	INCREASE (FEET)
Columbia River								
A	96.49	3,550 / 1,450	165,476	4.6	28.9	29.0	29.8	0.8
B	98.43	3,950 / 1,130	159,986	4.8	29.4	29.6	30.4	0.8
C	99.28	3,057 / 1,198[6]	140,334	5.4	29.7	29.9	30.6	0.7
D	100.43	3,548 / 1,408[6]	168,626	4.5	29.9	30.4	31.1	0.7
E	101.20	3,363 / 1,230[7]	195,911	3.9	30.1	30.7	31.3	0.6
F	102.18	3,233 / 2,360	222,371	2.5	30.3	31.0	31.6	0.6
G	104.43	3,630 / 2,290	184,160	3.1	30.9	31.2	31.9	0.7
M[5]	111.15	4,619 / 2,087[7]	185,625	3.0	32.6	32.3	33.2	0.9
N	112.93	7,375 / 5,061[7]	192,568	2.9	32.9	32.6	33.5	0.9
O	115.02	4,312 / 2,599[7]	161,857	3.5	33.5	33.0	33.9	0.9
P	116.10	4,773 / 2,926[7]	178,406	3.2	33.8	33.3	34.2	0.9
Q	118.06	6,998 / 3,387[6, 7]	210,779	2.7	34.3	33.7	34.5	0.8
R	119.88	2,280 / 970	127,035	4.4	34.7	34.0	34.8	0.8
S	121.37	4,250 / 3,270	157,277	3.6	35.0	34.4	35.2	0.8
T	122.86	5,500 / 3,700	189,310	2.9	35.2	34.8	35.6	0.8
U	123.42	5,700 / 3,610	197,499	2.80	35.4	34.9	35.8	0.9
V	123.98	5,800 / 3,415[7]	206,916	2.70	35.5	34.9	35.8	0.9
W	125.54	6,950 / 2,200	198,505	2.80	35.7	35.2	36.1	0.9
X	126.58	5,900 / 600	173,646	3.20	35.9	35.3	36.2	0.9

[1] Miles above mouth [2] Width/width within study area [3] Elevations based on combined stage-frequency curve

[4] Elevations based on HEC-2 model calibrated to approximate 1-percent annual-chance combined stage-frequency curve

[5] Cross sections H through L are located entirely within the City of Portland – See FIS for City of Portland, OR Community No. 410183

[6] Includes width of levee to landward toe [7] Width Within Study Area reflects political boundaries as of August 2008

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

COLUMBIA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek								
A	72	---[3]	---[3]	---[3]	20.0[2]	20.0	---[3]	---[3]
B	610	---[3]	---[3]	---[3]	20.1[2]	20.1	---[3]	---[3]
C	790	---[3]	---[3]	---[3]	20.1[2]	20.1	---[3]	---[3]
D	810	---[3]	---[3]	---[3]	20.2[2]	20.2	---[3]	---[3]
E	1,150	---[3]	---[3]	---[3]	20.3[2]	20.3	---[3]	---[3]
F	1,771	38	144	3.1	20.3	20.3	20.3	0.0
G	2,041	35	137	3.3	20.5	20.5	20.7	0.2
H	2,601	50	119	3.8	21.0	21.0	21.3	0.3
I	2,870	---[3]	---[3]	---[3]	21.9[2]	21.9	---[3]	---[3]
J	2,930	---[3]	---[3]	---[3]	28.5[2]	28.5	---[3]	---[3]
K	3,320	---[3]	---[3]	---[3]	28.9[2]	28.9	---[3]	---[3]
L	3,610	---[3]	---[3]	---[3]	31.2[2]	31.2	---[3]	---[3]
M	3,800	---[3]	---[3]	---[3]	31.2[2]	31.2	---[3]	---[3]
N	3,980	---[3]	---[3]	---[3]	31.7[2]	31.7	---[3]	---[3]
O	4,100	---[3]	---[3]	---[3]	34.4[2]	34.4	---[3]	---[3]
P	4,160	---[3]	---[3]	---[3]	38.9[2]	38.9	---[3]	---[3]
Q	4,200	---[3]	---[3]	---[3]	45.4[2]	45.4	---[3]	---[3]
R	4,380	---[3]	---[3]	---[3]	45.7[2]	45.7	---[3]	---[3]
S	4,540	---[3]	---[3]	---[3]	48.9[2]	48.9	---[3]	---[3]
T	4,850	---[3]	---[3]	---[3]	56.9[2]	56.9	---[3]	---[3]
U	5,150	---[3]	---[3]	---[3]	88.4[2]	88.4	---[3]	---[3]
V	5,340	---[3]	---[3]	---[3]	94.8[2]	94.8	---[3]	---[3]
W	5,780	---[3]	---[3]	---[3]	102.3[2]	102.3	---[3]	---[3]
X	6,060	---[3]	---[3]	---[3]	110.9[2]	110.9	---[3]	---[3]

[1] Feet above mouth [2] Values read from effective flood profiles [3] Data not available

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek (continued)								
Y	6,250	---[3]	---[3]	---[3]	115.8[2]	115.8	---[3]	---[3]
Z	6,300	---[3]	---[3]	---[3]	122.9[2]	122.9	---[3]	---[3]
AA	6,625	---[3]	---[3]	---[3]	128.1[2]	128.1	---[3]	---[3]
AB	6,748	---[3]	---[3]	---[3]	130.9[2]	130.9	---[3]	---[3]
AC	6,965	---[3]	---[3]	---[3]	132.7[2]	132.7	---[3]	---[3]
AD	7,180	---[3]	---[3]	---[3]	134.9[2]	134.9	---[3]	---[3]
AE	7,305	---[3]	---[3]	---[3]	143.8[2]	143.8	---[3]	---[3]
AF	7,532	30	71	4.9	150.8	150.8	151.0	0.2
AG	7,665	50	227	1.5	151.3	151.3	151.8	0.5
AH	7,835	45	168	2.1	151.5	151.5	152.0	0.5
AI	8,185	30	95	3.7	152.4	152.4	152.8	0.4
AJ	8,337	37	74	4.7	158.9	158.9	159.2	0.3
AK	8,392	56	369	1.0	159.4	159.4	159.8	0.4
AL	8,527	55	128	2.8	159.5	159.5	160.0	0.5
AM	8,697	65	138	2.5	159.7	159.7	160.6	0.9
AN	8,727	70	157	2.2	160.2	160.2	161.2	1.0
AO	9,117	86	223	1.5	162.6	162.6	162.6	0.0
AP	9,517	48	77	4.4	165.4	165.4	165.4	0.0
AQ	9,757	48	139	2.4	169.6	169.6	169.6	0.0
AR	10,137	54	101	3.4	174.3	174.3	174.3	0.0
AS	10,672	66	106	3.2	182.2	182.2	182.2	0.0
AT	11,079	87	200	1.7	188.7	188.7	188.7	0.0
AU	11,759	34	81	1.9	192.9	192.9	193.2	0.3

[1] Feet above mouth [2] Values read from effective flood profiles [3] Data not available

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek (continued)								
AV	12,944	90	174	0.9	197.9	197.9	198.3	0.4
AW	14,052	80	87	1.5	200.6	200.6	201.1	0.5
AX	14,832	122[2]	35	3.8	205.4	205.4	206.0	0.6
AY	15,337	14	20	6.7	208.8	208.8	208.8	0.0
AZ	15,523	68	40	6.2	212.0	212.0	212.0	0.0
BA	15,998	80	775	0.4	212.3	212.3	212.9	0.6
BB	16,526	20	38	7.9	212.6	212.6	213.0	0.4
BC	16,632	24	77	3.7	221.9	221.9	222.8	0.9
BD	16,843	48	84	3.4	223.2	223.2	223.5	0.3
BE	16,896	60	151	1.9	224.3	224.3	225.3	1.0
BF	17,160	40	84	3.4	225.0	225.0	225.6	0.6
BG	17,567	25	62	4.4	230.7	230.7	231.5	0.8
BH	18,253	20	40	6.7	237.2	237.2	238.1	0.9
BI	18,897	21	51	5.1	243.5	243.5	244.3	0.8
BJ	19,036	65	64	4.1	247.4	247.4	247.4	0.0
BK	19,805	14	65	3.7	250.5	250.5	251.3	0.8
BL	20,640	22	67	3.4	254.2	254.2	254.2	0.0
BM	20,975	29	112	1.8	257.4	257.4	257.4	0.0
BN	21,245	64	46	4.3	257.7	257.7	258.0	0.3
BO	21,574	16	35	5.6	263.9	263.9	263.9	0.0
BP	21,749	68	177	1.1	264.6	264.6	264.7	0.1
BQ	22,099	126	335	0.6	264.6	264.6	264.8	0.2
BR	22,399	86	151	0.9	264.6	264.6	264.9	0.3

[1] Feet above mouth [2] Floodway width includes island in middle of channel

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek (continued)								
BS	22,633	120	256	0.5	264.8	264.8	265.3	0.5
BT	22,805	20	110	1.2	264.9	264.9	265.4	0.5
BU	22,910	45	160	0.8	266.4	266.4	267.2	0.8
BV	23,140	28	113	0.1	266.5	266.5	267.2	0.7
BW	23,540	5	32	1.6	266.5	266.5	267.2	0.7
BX	23,675	45	197	0.3	268.2	268.2	268.9	0.7
BY	25,245	21	76	0.7	268.3	268.3	268.9	0.6
BZ	25,585	15	82	0.5	268.5	268.5	269.0	0.5
CA	25,735	16	92	0.5	269.1	269.1	269.6	0.5
CB	26,270	37	123	0.4	269.2	269.2	269.7	0.5
CC	27,170	40	147	0.2	269.2	269.2	269.7	0.5
CD	28,040	60	233	0.1	269.2	269.2	269.7	0.5

[1] Feet above mouth

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek (Left Overbank along Birdsdale Ave)								
A	707	36	76	0.8	264.6	264.6	264.9	0.3
B	922	44	83	0.7	264.6	264.6	264.9	0.3
C	972	161	354	0.2	264.7	264.7	264.9	0.2
D	1,442	38	122	0.5	264.7	264.7	265.0	0.3
E	2,042	53	25	2.3	265.3	265.3	265.5	0.2

[1] Feet upstream of the culvert under Portland Traction Company Railroad

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK (LEFT OVERBANK OVERFLOW ALONG BIRDSDALE AVENUE)

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Fairview Creek (Right bank overflow along Northeast Glisan Street)								
A	54	125	67	2.6	204.5	204.5	204.7	0.2
B	346	103	359	0.5	204.7	204.7	205.0	0.3
C	496	48	96	1.8	204.7	204.7	205.0	0.3
D	996	24	29	6.1	207.1	207.1	207.8	0.7
E	1,376	57	108	1.6	209.3	209.3	210.2	0.9
F	1,721	36	61	2.9	210.2	210.2	211.1	0.9
G	2,124	63	124	1.4	211.0	211.0	211.9	0.9

[1] Feet above upstream end of culvert at Northeast Glisan Street

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

FAIRVIEW CREEK (RIGHT OVERFLOW ALONG NORTHEAST GLISAN STREET

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Johnson Creek								
BB[3]	11.733	130 / 10[2]	694	3.7	250.2	250.2	251.1	0.9
BC	11.823	129 / 24[2]	819	3.1	250.9	250.9	251.7	0.8
BD	11.928	155	710	3.6	251.7	251.7	252.5	0.8
BE	11.969	57	543	4.7	254.1	254.1	255.0	0.9
BF	12.099	79 / 47[2]	808	3.1	255.2	255.2	255.8	0.6
BG	12.337	50	300	8.3	255.5	255.5	256.0	0.5
BH	12.572	48	357	6.9	259.8	259.8	259.9	0.1
BI	12.665	74	714	3.5	260.6	260.6	261.1	0.5
BJ	12.782	50	495	6.9	262.6	262.6	263.4	0.8
BK	12.814	70	840	4.1	263.9	263.9	264.6	0.7
BL	13.011	75	790	4.2	265.2	265.2	265.6	0.4
BM	13.155	75	685	4.9	265.7	265.7	266.3	0.6
BN	13.409	35	420	8.1	266.9	266.9	267.7	0.8
BO	13.420	40	385	8.7	267.4	267.4	267.9	0.5
BP	13.703	115	485	6.9	269.3	269.3	270.2	0.9
BQ	13.967	130	850	4	272.6	272.6	273.3	0.7
BR	14.158	180	700	4.8	274.0	274.0	274.8	0.8
BS	14.338	130	585	5.8	279.0	279.0	279.1	0.1
BT	14.489	95	700	4.9	281.3	281.3	281.6	0.3
BU	14.593	55	380	8.9	282.2	282.2	282.8	0.6
BV	14.685	60	465	7.3	284.4	284.4	285.1	0.7
BW	14.705	45	425	8	284.6	284.6	285.4	0.8
BX	14.832	60	515	6.6	286.9	286.9	287.3	0.4
BY	14.931	65	685	4.8	288.0	288.0	288.8	0.8

[1] Miles above mouth [2] Width/width within study area

[3] Cross sections A through BA are located within the City of Portland – See FIS for City of Portland, OR Community No. 410183

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

JOHNSON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Johnson Creek (continued)								
BZ	15.030	130	945	3.4	288.6	288.6	289.4	0.8
CA	15.102	210	1395	2.4	289.0	289.0	289.9	0.9
CB	15.225	220	1155	3	289.3	289.3	290.3	1.0
CC	15.331	90	465	6.9	289.8	289.8	290.6	0.8
CD	15.441	75	500	6.8	291.5	291.5	292.5	1.0
CE	15.555	80	365	9.4	294.0	294.0	294.3	0.3
CF	15.604	65	275	12.4	296.0	296.0	296.0	0.0
CG	15.627	55	515	6.6	297.9	297.9	298.8	0.9
CH	15.656	85	790	4.4	298.6	298.6	299.5	0.9
CI	15.733	55	415	8.2	299.1	299.1	299.9	0.8
CJ	15.851	35	375	9.1	300.8	300.8	301.2	0.4
CK	15.876	65 / 45[2]	1,235	2.5	303.0	303.0	303.2	0.2
CL	15.920	110	1,015	2.8	303.0	303.0	303.2	0.2
CM	15.954	70	815	3.5	303.0	303.0	303.2	0.2
CN	15.965	65	765	3.7	303.3	303.3	303.6	0.3
CO	15.990	65	660	4.6	303.7	303.7	303.8	0.1
CP	16.010	105	885	3.2	303.9	303.9	304.2	0.3
CQ	16.112	135	915	3.1	304.2	304.2	304.9	0.7
CR	16.234	75	800	3.6	307.1	307.1	307.4	0.3
CS	16.342	110	655	4.3	307.5	307.5	307.9	0.4
CT	16.444	110	830	3.5	308.2	308.2	308.9	0.7
CU	16.480	55	390	7.5	308.3	308.3	309.2	0.9
CV	16.551	105	695	5.1	310.5	310.5	311.2	0.7

[1] Miles above mouth [2] Left channel / right channel

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

JOHNSON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Johnson Creek (continued)								
CW	16.731	130	370	7.8	314.2	314.2	314.2	0.0
CX	16.750	40	240	11.8	314.9	314.9	315.1	0.2
CY	16.830	185	1,035	3.8	318.3	318.3	318.4	0.1
CZ	17.083	55	230	10.4	324.7	324.7	325.2	0.5
DA	17.200	120	860	4.7	330.4	330.4	330.6	0.2
DB	17.456	60	325	6.8	336.9	336.9	337.7	0.8
DC	17.467	35	185	13.5	336.9	336.9	337.7	0.8
DD	17.587	135	760	3.3	341.1	341.1	341.2	0.1
DE	18.066	120	425	6.0	354.4	354.4	354.7	0.3
DF	18.228	75	377	6.6	359.7	359.7	360.6	0.9
DG	18.335	44	269	9.3	363.0	363.0	364.0	1.0
DH	18.583	123	699	3.6	376.2	376.2	377.2	1.0
DI	18.719	60	329	7.6	377.7	377.7	378.6	0.9
DJ	18.919	80	340	7.4	385.6	385.6	386.4	0.8
DK	19.053	87	440	5.7	390.3	390.3	391.2	0.9
DL	19.242	144	524	4.5	397.5	397.5	398.3	0.8
DM	19.427	62	247	4.0	404.1	404.1	405.1	1.0
DN	19.432	135	733	1.4	404.5	404.5	405.4	0.9
DO	19.444	170	1,067	0.9	405.8	405.8	406.8	1.0
DP	19.600	31	138	7.2	408.8	408.8	409.7	0.9
DQ	19.856	73	413	2.4	418.4	418.4	419.2	0.8
DR	20.515	26	93	10.6	439.1	439.1	439.8	0.7
DS	20.650	200	451	2.2	445.9	445.9	446.9	1.0

[1] Miles above mouth

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

JOHNSON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Johnson Creek (continued)								
DT	20.670	258	1,669	0.6	450.3	450.3	451.1	0.8
DU	20.770	57	182	5.5	451.3	451.3	452.3	1.0
DV	20.951	39	161	6.1	458.9	458.9	459.6	0.7
DW	21.153	73	233	4.30	463.9	463.9	464.5	0.6
DX	21.389	29	124	8.00	472.2	472.2	472.7	0.5
DY	21.472	77	309	3.20	474.4	474.4	475.1	0.7
DZ	21.545	40	151	6.60	476.0	476.0	476.7	0.7
EA	21.668	30	143	6.90	481.3	481.3	481.8	0.5
EB	21.677	30	218	4.50	483.9	483.9	484.5	0.6
EC	21.777	33	130	7.60	485.6	485.6	486.5	0.9
ED	22.000	61	215	4.60	494.7	494.7	495.5	0.8
EE	22.144	93	265	2.20	496.3	496.3	497.3	1.0
EF	22.211	29 / 15[2]	90	6.40	497.7	497.7	498.3	0.6

[1] Miles above mouth [2] Width / width within study area

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

JOHNSON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Kelly Creek								
A	160	46	376	2.0	306.1	306.1	306.2	0.1
B	412	31	188	3.9	306.1	306.1	306.2	0.1
C	764	17	66	11.2	309.6	309.6	309.6	0.0
D	1,026	14	45	10.1	313.6	313.6	313.6	0.0
E	1,136	17	48	9.5	317.3	317.3	317.3	0.0
F	1,296	19	49	9.2	322.2	322.2	322.2	0.0
G	1,801	20	50	9.1	327.3	327.3	327.3	0.0
H	2,031	27	67	6.8	330.5	330.5	330.6	0.1
I	2,351	22	60	7.6	332.4	332.4	332.7	0.3
J	2,516	50	105	4.3	334.3	334.3	334.4	0.1
K	2,931	20	70	6.5	335.9	335.9	336.2	0.3
L	3,356	15	88	5.4	338.2	338.2	338.7	0.5
M	3,926	16	109	4.8	343.4	343.4	343.4	0.0
N	4,140	12	46	8.3	343.4	343.4	343.5	0.1
O	4,423	22	109	4.2	346.4	346.4	346.4	0.0
P	4,628	35	148	2.10	346.7	346.7	346.7	0.0
Q	5,098	27	101	3.10	346.9	346.9	347.0	0.1
R	5,437	24	58	4.60	347.5	347.5	347.7	0.2
S	5,767	25	121	3.10	354.3	354.3	354.3	0.0
T	6,341	26	109	2.50	354.5	354.5	354.7	0.2
U	6,649	26	75	3.60	354.8	354.8	355.1	0.3
V	7,039	16	45	6.00	356.3	356.3	356.3	0.0
W	7,683	24	52	5.80	360.3	360.3	360.4	0.1
X	7,940	26	116	1.90	366.0	366.0	366.0	0.0

[1] Feet above downstream end of culvert at Kane Road

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

KELLY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Kelly Creek (continued)								
Y	8,580	18	65	3.80	366.2	366.2	366.3	0.1
Z	9,290	28	36	6.90	369.5	369.5	369.5	0.0
AA	10,120	40	68	4.4	379.1	379.1	379.1	0.0
AB	10,555	17	28	7.9	385.2	385.2	385.6	0.4
AC	10,736	20	95	2.6	390.1	390.1	390.1	0.0
AD	11,200	21	51	3.9	390.4	390.4	390.4	0.0
AE	12,020	18	26	6.9	395.8	395.8	395.8	0.0
AF	12,844	15	40	3.9	403.1	403.1	403.1	0.0
AG	13,013	56	417	0.4	406.3	406.3	406.3	0.0
AH	13,287	60	335	0.5	406.3	406.3	406.3	0.0
AI	13,677	14	22	7.1	406.8	406.8	406.8	0.0
AJ	14,177	17	37	4.3	412.2	412.2	412.2	0.0
AK	14,425	8	18	8.6	416.2	416.2	416.2	0.0
AL	15,288	25	23	5.5	425.5	425.5	425.5	0.0
AM	15,498	38	139	1.7	428.3	428.3	428.3	0.0
AN	15,778	22	22	6.2	428.2	428.2	428.2	0.0
AO	16,458	40	35	3.5	436.9	436.9	436.9	0.0
AP	16,747	40	34	2.9	439.3	439.3	439.3	0.0
AQ	17,089	43	123	0.7	447.3	447.3	447.3	0.0

[1] Feet above downstream end of culvert at Kane Road

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

KELLY CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY[2] (FEET NAVD)	WITH FLOODWAY[2] (FEET NAVD)	INCREASE (FEET)
Multnomah Channel								
A	12.68	800	28,977	3.9	28.8	26.8	27.7	0.9
B	14.79	760	28,278	4.0	29.6	27.4	28.3	0.9
C	17.03	800	30,177	3.7	30.0	28.0	28.8	0.8
D	19.08	870[3]	30,687	3.6	30.5	28.3	29.2	0.9
E	20.55	836[3]	40,034	2.8	30.7	28.5	29.5	1.0
F	21.21	800	38,085	2.9	30.8	28.6	29.6	1.0

[1] Miles above mouth [2] Elevations computed without consideration of influence from Columbia and Willamette Rivers

[3] Includes width of levee to landward toe

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

MULTNOMAH CHANNEL

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Sandy River								
A	2.40	750	13,950	5.9	35.5	35.5	36.4	0.9
B	2.42	894	15,920	5.2	35.7	35.7	36.5	0.8
C	2.57	501[2]	9,210	9.0	35.6	35.6	36.4	0.8
D	2.61	519	9,350	8.9	36.0	36.0	36.8	0.8
E	2.62	519[2]	10,060	8.2	36.3	36.3	37.0	0.7
F	2.83	352	6,190	12.8	37.4	37.4	37.8	0.4
G	2.95	330	6,910	11.4	40.1	40.1	40.6	0.5
H	2.98	340	6,880	11.5	40.7	40.7	41.3	0.6
I	3.02	630	12,260	6.6	42.8	42.8	43.3	0.5
J	3.22	988	14,060	5.7	43.4	43.4	43.8	0.4
K	3.56	358	7,750	10.4	43.8	43.8	44.6	0.8
L	4.06	529[3]	10,880	7.4	46.6	46.6	47.3	0.7
M	4.35	365	8,735	9.2	46.0	46.0	47.0	1.0
N	4.55	644	11,994	6.7	47.7	47.7	48.7	1.0
O	4.64	490	10,641	7.6	48.0	48.0	49.0	1.0
P	5.04	467	9,764	8.22	50.0	50.0	51.0	1.0
Q	5.42	281	6,892	11.65	51.3	51.3	52.3	1.0
R	5.76	226	5,908	13.57	53.0	53.0	54.0	1.0
S	5.79	253	6,452	12.43	53.9	53.9	54.9	1.0
T	6.17	786	17,309	4.63	56.5	56.5	57.5	1.0

[1] Miles above mouth [2] Floodway width reduced to floodplain width [3] Floodway width includes sand bar in middle of channel

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

SANDY RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Unnamed Tributary to Rock Creek								
A	0.74	80 / 15[2]	122	2.7	204.4	204.4	204.9	0.5
B	0.86	100[3]	173	1.9	207.8	207.8	208.4	0.6
C	0.97	64	106	3.2	210.7	210.7	211.0	0.3
D	1.16	148	263	1.3	214.0	214.0	214.5	0.5
E	1.19	8	32	10.4	214.5	214.5	214.5	0.0
F	1.33	85	173	0.7	218.5	218.5	219.3	0.8

[1] Miles above mouth [2] Width/Width within county limits [3] Floodway located entirely outside county limits

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED TRIBUTARY TO ROCK CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
Willamette River								
A	0.38	1600 / 799[3]	85,130	3.1	30.8	29.3[4]	30.1[4]	0.8
B	1.52	1700 / 1020[3]	113,090	2.3	30.9	29.4[4]	30.2[4]	0.8
C	2.40	2300 / 1126[3]	142,790	1.8	30.9	29.5[4]	30.3[4]	0.8
D	3.03	2073 / 829[3]	110,545	2.4	30.9	29.5[4]	30.3[4]	0.8
AE[2]	17.83	985 / 16[3]	63,627	5.9	35.1	35.1	36.0	0.9
AF	18.31	815 / 66[3]	51,102	7.3	35.4	35.4	36.3	0.9
AG	18.63	1325 / 25[3]	85,861	4.4	36.2	36.2	37.0	0.8
AH	19.10	1530 / 24[3]	63,914	5.9	36.2	36.2	37.0	0.8

[1] Miles above mouth [2] Cross sections E through AD are located within the City of Portland – See FIS for City of Portland, OR Community No. 410183

[3] Width / Width within study area [4] Elevation computed without consideration of influence from Columbia River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON AND INCORPORATED AREAS

FLOODWAY DATA

WILLAMETTE RIVER

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (100-year) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

Table 9 lists the flood insurance zones that each community is responsible for regulating.

Table 9. Flood Insurance Zones Within Each Community

Community	Flood Zone(s)
Fairview, City of	A, AE, AH, X
Gresham, City of	A, AE, AH, AO, X
Multnomah County, Unincorporated Areas	A, AE, AH, X
Troutdale, City of	A, AE, X
Wood Village, City of	X

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide Flood Insurance Rate Map presents flooding information for the entire geographic area of Multnomah County (Excluding the City of Portland). Previously, Flood Insurance Rate Maps were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide Flood Insurance Rate Map also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to maps prepared for each community are presented in Table 10.

7.0 OTHER STUDIES

This study is compatible with the Flood Insurance Studies or Flood Hazard Boundary Maps for the City of Vancouver, Washington (Reference 63). There is a slight discrepancy between some elevations shown for Willamette River for this study and those shown for the Flood Insurance Study for the City of Milwaukie, Oregon (Reference 64). These differences are due to the different analyses performed for these studies. This study is compatible with the Flood Hazard Boundary Maps or Flood Insurance Studies for the Cities of Portland (Reference 47), and Wood Village, Oregon (Reference 65), and the unincorporated areas of Hood River County (Reference 66), Washington County (Reference 67), and Columbia County (Reference 68). The Flood Insurance Study for the unincorporated areas of Clark County, Washington (Reference 69), and the restudy of the unincorporated areas of Clackamas County, Oregon (Reference 70), are in agreement with this study.

There are no flood hazard areas in common between the City of Lake Oswego, Oregon (Reference 71), and this study.

The USACE Flood Plain Information report for Milwaukie-Oak Grove-Lake Oswego, which was prepared in 1970 (Reference 72), included Johnson Creek flood profiles. The 1-percent-annual-chance flood profile varies within approximately 2 feet of the profile shown in this study. The variation is attributed to slightly different discharge values, changes in stream configuration, development in the flood plain, and more accurate computer modeling techniques.

The USACE Columbia and Willamette River flood profiles have been revised for this study by statistically combining spring-summer and fall-winter flood events. The Columbia River spring-summer and fall-winter 1-percent-annual-chance flood crests (References 57 and 73), are approximately 1.5 and 2 feet, respectively, below the 1-percent-annual-chance combined flood

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Fairview, City of	May 10, 1974	February 28, 1975	September 30, 1987	June 17, 1991 July 3, 1995
Gresham, City of	December 7, 1973	April 30, 1976	July 16, 1979	January 18, 1984 June 17, 1986 September 28, 1990 February 16, 1996 May 2, 2002
*Maywood Park, City of	---	---	---	---
Multnomah County (Unincorporated Areas)	February 4, 1972	---	June 15, 1982	March 18, 1986
Troutdale, City of	December 7, 1973	June 4, 1976 March 20, 1979	September 30, 1988	March 18, 1986 August 3, 1998
*Wood Village, City of	---	---	---	---

*Non-Floodprone

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH COUNTY, OREGON
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

elevation shown at Vancouver Gage in this study. The Willamette River 1-percent-annual-chance flood profile (Reference 74) is approximately 2 feet lower than that used in this study near the Portland downstream limit, approximately 1 foot lower near the Morrison Street Bridge, and nearly the same elevation at Sellwood Bridge.

The City of Portland, Multnomah County Drainage District No. 1, and the Port of Portland published Multnomah Drainage District No.1 Hydrology Study in July 1984 (Reference 1). That report was used to lower the 1-percent-annual-chance flood elevations within the district.

The SCS prepared a Flood Hazard Analysis, Lower Sandy River and Beaver Creek, dated October 1977, for the City of Troutdale and Multnomah County (Reference 38). Much of the basic data from that study was used in this study.

The portions of Sandy River flood profiles which came from the SCS Flood Hazard Analysis for Sandy River (Reference 38) vary from the water-surface elevations computed by the USACE HEC-2 computer program. The differences are greatest in the area from the UPRR trestle upstream to the Crown Point Road bridge and result from internal differences in how the computer programs handle bridges.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP. Previous studies include Flood Insurance Study Reports for the City of Fairview (Reference 75), City of Gresham (Reference 76), City of Troutdale (Reference 77), and Multnomah County Unincorporated Areas (Reference 78).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Mitigation Division, Federal Regional Center, 130 228th Street, SW, Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data located at Map Repository, 1600 SE 190th, 1st Floor, Gresham, OR 97233.

10.1 First Revision

This City of Fairview study was revised on July 3, 1995, to add base flood elevations, and to update the flood boundary delineations for Fairview Creek from Bridge Street to Fairview Lake.

The hydrologic analysis from the 1991 Flood Insurance Study for the City of Fairview was used for this version.

The hydraulic analysis was performed by the U.S. Department of the Army, Corps of Engineers (USACE), Portland District, for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-90-E-3286. The study was completed in June 1991.

The results of this study were reviewed at the Final Consultation and Coordination Officer meeting held on April 28, 1994, and attended by representatives of the City of Fairview, FEMA, and the U.S. Army Corps of Engineers, Portland District.

The hydraulic analysis conducted for this study utilized the USACE HEC-2 computer model (Reference 27). Cross-sectional data were obtained from the field surveys performed in May 1991, and were supplemented with topographic maps provided by Multnomah County. The 1-percent-annual-chance flood elevation calculated at the farm road crossing, which acts as a weir, at the outlet of Fairview Lake was used as the starting-water surface elevation. The revised floodway was established using equal conveyance. The results are shown on Table 8.

The City of Gresham Flood Insurance Study was revised on February 16, 1996, to incorporate the results of a detailed hydrologic and hydraulic analysis of Kelly Creek affecting the City of Gresham and Multnomah County, Oregon. The revised analysis was performed by the USACE, Portland District, for FEMA, under Inter-Agency Agreement No. EMW-91-E-3529, Project Order No. 8A. This work was completed in June 1992.

A detailed study was performed for Kelly Creek from the Mount Hood Community College (MHCC) dam, approximately 1,100 feet downstream of Northeast Kane Road, upstream to Northeast Division Street, a distance of approximately 0.8 miles. The flow estimates were developed by the USACE using the HEC-1 computer program (Reference 33). The input parameters were estimated based on correlation with a study done by URS Corporation of Kelly Creek in 1988, and a Master Drainage Plan Report done by KCM, Inc., in 1988 for Fairview Creek, which is just west of Kelly Creek basin in Gresham (Reference 34).

The hydraulic analysis for the revised study was performed using the USACE HEC-2 step-backwater computer program (Reference 27). Data for the cross section, including overbank areas, were taken from topographic maps at a scale of 1”=100’, with a contour interval of 2 feet (Reference 49). Data at the Kane Road culvert and MHCC outlet structure were surveyed in past years and verified by a field visit in March 1992.

Channel and overbank roughness coefficients (Manning's "n") used in the computer program were estimated from experience and field observations. A value of 0.035 was used for the channel and values ranged from 0.038 to 0.042 for the overbank areas. The starting water-surface elevation was obtained from a rating curve computed at the upstream end of the culvert at Kane Road. The hydraulic study included the backwater effect from the MHCC dam on the culvert outlet at Kane Road.

The floodway was computed using Method 4 of the HEC-2 computer model from Kane Road to approximately 522 feet upstream. Method 6, with a 1.0-foot allowable rise in the energy grade line, was used from this point to approximately 3,161 feet upstream. Method 6, with a 0.1-foot allowable rise in the energy grade line, was used from this point to the limit of detailed study at Division Street.

The floodway and 1- and 0.2-percent-annual-chance floodplain boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps. In cases where the lines are collinear, only the floodway boundary has been shown.

Table 6, "Summary of Discharges," Table 8 "Floodway Data," and the Profile Panels were also revised to reflect the results of this detailed study.

10.2 Second Revision

The City of Gresham Flood Insurance Study was revised on May 2, 2002, to show modifications to flood hazards along an approximate 3 mile reach of Kelly Creek. Kelly Creek was restudied from the crossing at NE Division Street upstream to approximately 600 feet upstream of 282nd Street.

The hydrologic and hydraulic analyses for the restudy were performed by Odgen Beeman and Associates, Inc., for the Federal Emergency Management Agency (FEMA), under contract No. EMS-96-CO-0078-TA05. This study was completed in September 1998. Water-surface elevations immediately upstream of Kane Road and the Kelly Creek Storm Water Detention Facility were adjusted by FEMA in October 2000 utilizing data provided by the City of Gresham.

Contacts made to acquire historical data for the restudy included, the City of Gresham, U.S. Army Corps of Engineers (USACE), Portland District, and FEMA.

The results of the study were reviewed at the final Consultation Coordination Officer meeting held on May 3, 2001, and attended by representatives of the City of Gresham, Parsons Brinkerhoff/Odgen Beeman, and FEMA. All problems raised at the meeting have been addressed in the restudy.

Discharges used in the restudy were taken from a previous study of Kelly Creek, based on HEC-1 modeling, performed by the USACE (Reference 35). The reach of the previous study extended from the downstream crossing of Kane Road, near Mount Hood Community College, upstream to NE Division Street. The discharge values in this reach were compared with the U.S. Geological Survey (USGS) regression equations to verify their accuracy. They were then adjusted by a drainage area ratio at seven locations on the restudy reach. The peak discharges used in this restudy for the 10-, 2-, and 1-, and 0.2-percent-annual-chance floods are shown in Table 6, “Summary of Discharges”.

The hydraulic analysis for Kelly Creek was performed using the HEC-RAS step-backwater computer program, Version 2.1 (Reference 50), to provide the water-surface elevations along the study reach. The starting water-surface elevation was taken from the results of the previous hydraulic study performed by the USACE (Reference 35), directly downstream of the restudy reach. The model was run in a sub-critical flow regime to estimate the flood profiles.

Cross section locations were chosen based on field investigations and USGS quadrangle maps (Reference 40). Chase, Jones & Associates, Inc. (Reference 51) surveyed fourteen cross sections in the restudy reach. Other cross sections were taken from the City of Gresham’s 1”=200’ two foot contour interval topographic maps (Reference 52). The first three downstream cross sections were repeated from the previous study completed on Kelly Creek, directly downstream of the restudy reach (Reference 35). All of the culverts, roads, detention facilities, and bridges were surveyed by Chase Jones and Associates, Inc. (Reference 51).

Manning’s “n” values chosen varied from 0.06 to 0.08 for the left and right overbanks and 0.04 for the channel, based on field observations. The Manning’s “n” values were repeated for the cross sections duplicated from the downstream study.

The City of Gresham provided two-foot contour interval topographic maps (Reference 52), based on aerial photography in 1990. These maps were used as the base map and to delineate the floodplain based on the flood profiles.

The floodway corresponding to the 1-percent-annual-chance flood was initially determined using method 4 encroachment analysis in HEC-RAS (Reference 50), with a water-surface rise of one foot. The method 4 approach was then converted to method 1 and modified to ensure the floodway did not encroach inside the channel banks.

Table 6, “Summary of Discharges,” Table 8, “Floodway Data,” and Exhibit 1, “Flood Profiles,” were revised as a result of the restudy.

The City of Troutdale Flood Insurance Study was revised on August 3, 1998, to add detailed flood information, including the adoption of a regulatory floodway, along Beaver Creek, from just upstream of Jackson Park Road to approximately 200 feet downstream of Southeast Stark Street. This revision also included updating the corporate limits for the City of Troutdale and adding flood information for Sandy River previously shown on the Multnomah County, Oregon, Flood Insurance Rate Map dated March 18, 1986. The analyses for this revision were performed by the USACE, Portland District, for FEMA, under Contract No. EMW-94-E-4432, and was completed in April 1995.

Flooding along Beaver Creek occurs from two sources. Overflow from Sandy River creates a backwater effect along Beaver Creek from its confluence point with the Sandy River to approximately 6,200 feet upstream. Flooding along the remainder of Beaver Creek is due only to flow originating from the Beaver Creek watershed. Because of the backwater effects from the Sandy River, the lower portion of Beaver Creek is a level pool with essentially constant elevations. From approximately 6,200 feet upstream, the steep slope of the basin results in supercritical flow.

The hydrologic analyses for this portion of Beaver Creek were obtained from the FIS report for the City of Troutdale (Reference 53). This analysis was performed by the National Resources Conservation Service (formerly the SCS), Oregon State Office. Stream flow data at gaging stations in the Sandy River basin were processed in accordance with the method described by the Water Resources Council (Reference 54). A regional analysis of the peak flow-frequency characteristics as a function of the drainage area was made and used to determine the unit peak discharge-frequency for Beaver Creek as shown in Table 6. The discharge at Troutdale Road was obtained by prorating the discharge at Southeast Stark Street to account for the reduction in drainage area.

The hydraulic analysis of Beaver Creek was performed using the USACE HEC-2 step-backwater program (Reference 55). Starting water-surface elevations just upstream of Jackson Park Road were taken from the previous published FIS. Cross-section information was developed from topographic work maps at a scale of 1”=100’, with a contour interval of 2 feet (Reference 56). Roughness factors (Manning’s “n”) used in the hydraulic computations were chosen based on engineering judgment and field observations of the channel and overbank areas. Manning’s “n” values of 0.04 and 0.07 were chosen for the channel and overbanks, respectively.

The floodway along the studied portion of Beaver Creek was computed on the basis of equal conveyance reduction from each side of the floodplain. From just upstream of Jackson Park Road to approximately 3,100 feet upstream, and from Troutdale Road to Southeast Stark Street, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the water surface. From 3,100 feet upstream of Jackson Park Road to Troutdale Road, the floodway width was determined by the width of the encroachment needed to cause a 1-foot rise in the energy gradeline.

The boundaries of the base floodplain and regulatory floodway and the flood boundaries associated with a flood having a 0.2-percent chance of being equaled or exceeded in any given year have been delineated using the flood elevations determined at each cross section, on topographic maps at a scale of 1”=100’, with a contour interval of 2 feet (Reference 56). The flood profiles for Beaver Creek were based on elevations obtained from the HEC-2 model. In the portion of Beaver Creek where supercritical flow occurs, critical depth elevations were plotted on the profile.

Table 11 summarizes the flooding sources updated since the original study was completed.

<u>Changes due to LOMR</u>

LOMR 00-10-462P revised the hydraulic analysis and floodplain mapping along Johnson Creek from its confluence with the Willamette River to approximately 2,000 feet upstream of 174th Avenue. The effective date was December 21, 2000. This LOMR superseded LOMR 00-10-173P.

LOMR 06-10-B082P revised the hydraulic analysis and floodplain mapping for Fairview Creek from approximately 1,130 feet downstream to approximately 300 feet downstream of Fairview Avenue and from approximately 400 feet upstream to approximately 4,250 feet upstream of NE Barr Road. The effective date was March 28, 2007.

Table 11. Revised Study Descriptions

Flooding Source(s)	Community	Limits of Study	Date of Revision	Panel No.
Fairview Creek	City of Fairview	Bridge Street to Fairview Lake	July 3, 1995	0212, 0216
Kelly Creek	City of Gresham, Multnomah County Unincorporated Areas	Mount Hood Community College dam to NE Division Street	February 16, 1996	0219
Kelly Creek	City of Gresham	NE Division Street to 282nd Street	May 2, 2002	0219, 0407, 0426
Beaver Creek	City of Troutdale	Jackson Park Road to SE Stark Street	August 3, 1998	0217, 0219

Countywide Update

The countywide update was performed by WEST Consultants, Inc. for the Federal Emergency Management Agency (FEMA), under Contract No. EMS-2001-CO-0068 and was completed in August 2008.

This update combined the Flood Insurance Rate Maps and Flood Insurance Study reports for Multnomah County and incorporated communities into the countywide format. Under the countywide format, Flood Insurance Rate Map panels have been produced using a single layout format for the entire area within the County instead of separate layout formats for each community. The single-layout format facilitates the matching of adjacent panels and depicts the flood-hazard area within the entire panel border, even in areas beyond a community's corporate boundary line. In addition, under the countywide format, this single Flood Insurance Study report provides all Flood Insurance Study information and data for the entire County area.

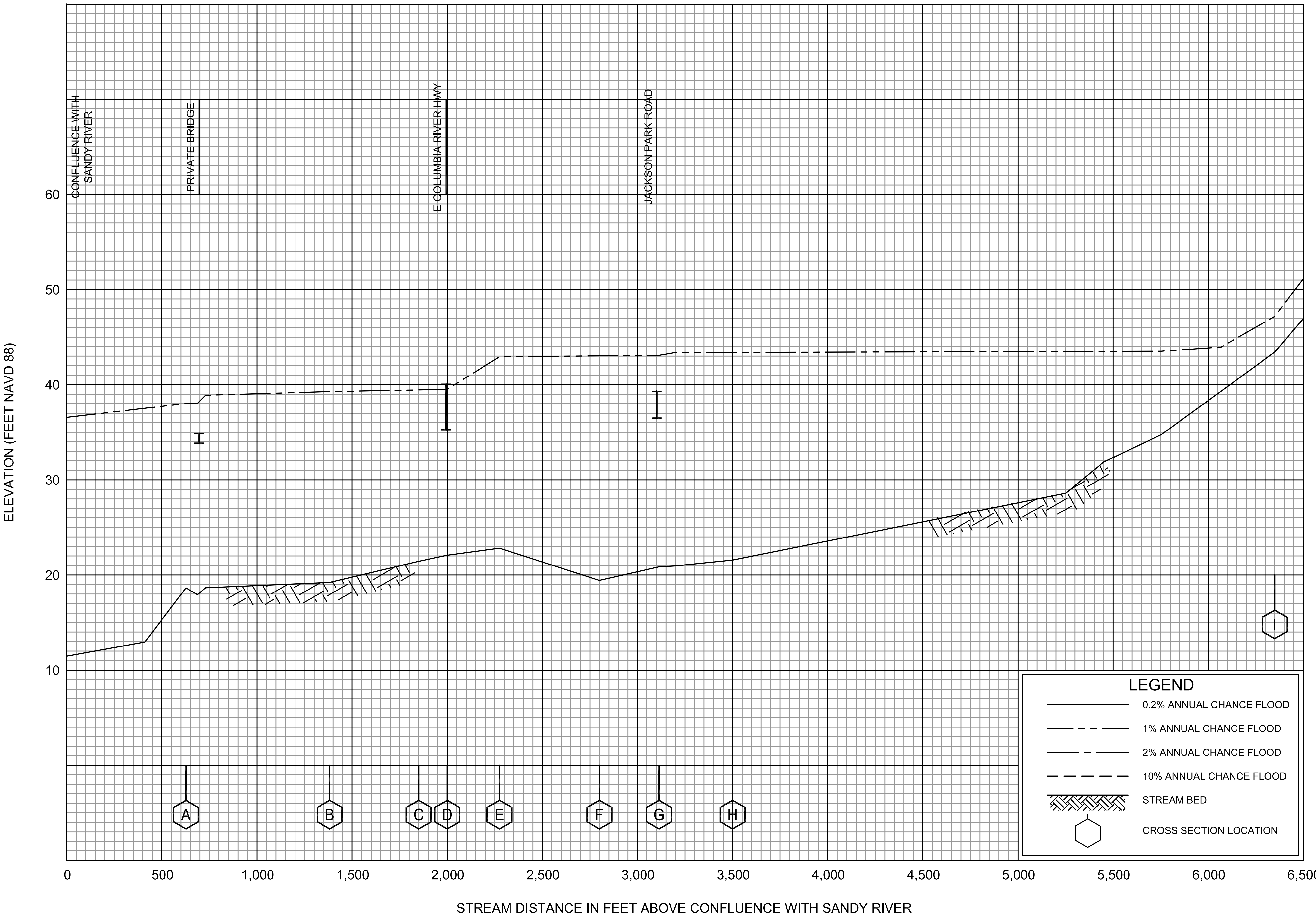
All flood elevations shown in this FIS report and on the FIRM panels were converted from NGVD 29 to NAVD 88. The conversion factor from NGVD to NAVD for all streams in this report is +3.43 feet.

As part of the countywide update, floodplain boundaries within the City of Fairview for portions of the Columbia River, Fairview Lake, Blue Lake, and Fairview Creek were revised based on topographic maps at a scale of 1:1,200 with a contour interval of 2 feet (Reference 59). Additionally, portions of the Columbia River, Sandy River, Willamette River, and Multnomah Channel were revised based on 2 foot contour interval topographic data developed from LiDAR data created by the Puget Sound LiDAR Consortium (Reference 60). The data can be used at a horizontal scale of 1:12,000 (1inch=1,000 feet) or smaller.

The floodway width at cross section F on the Sandy River was revised as part of the countywide update where new topography resulted in a mapped 1-percent annual chance floodplain that was narrower than the effective floodway. The floodway was mapped as coincident with the 1-percent annual chance floodplain.

In accordance with FEMA Guidelines and Specifications for Flood Hazard Mapping Partners (Reference 62), floodways which abut certified levees are to be mapped to the landward toe of the levee. Several locations where the effective mapping did not reflect this were revised and the floodway boundary was moved to the landward toe as determined by new topographic data (References 58 and 59). This was done for the Columbia River at cross sections C, D, and Q and for the Multnomah Channel at cross sections D and E. Floodway widths shown in Table 8 were updated to reflect the revised floodway boundary.

The floodplain boundaries for the remaining streams were digitized from the effective FIRM and Floodway panels. Aerial photography (Reference 61) was used to adjust floodplain and floodway boundaries where appropriate.



FLOOD PROFILES

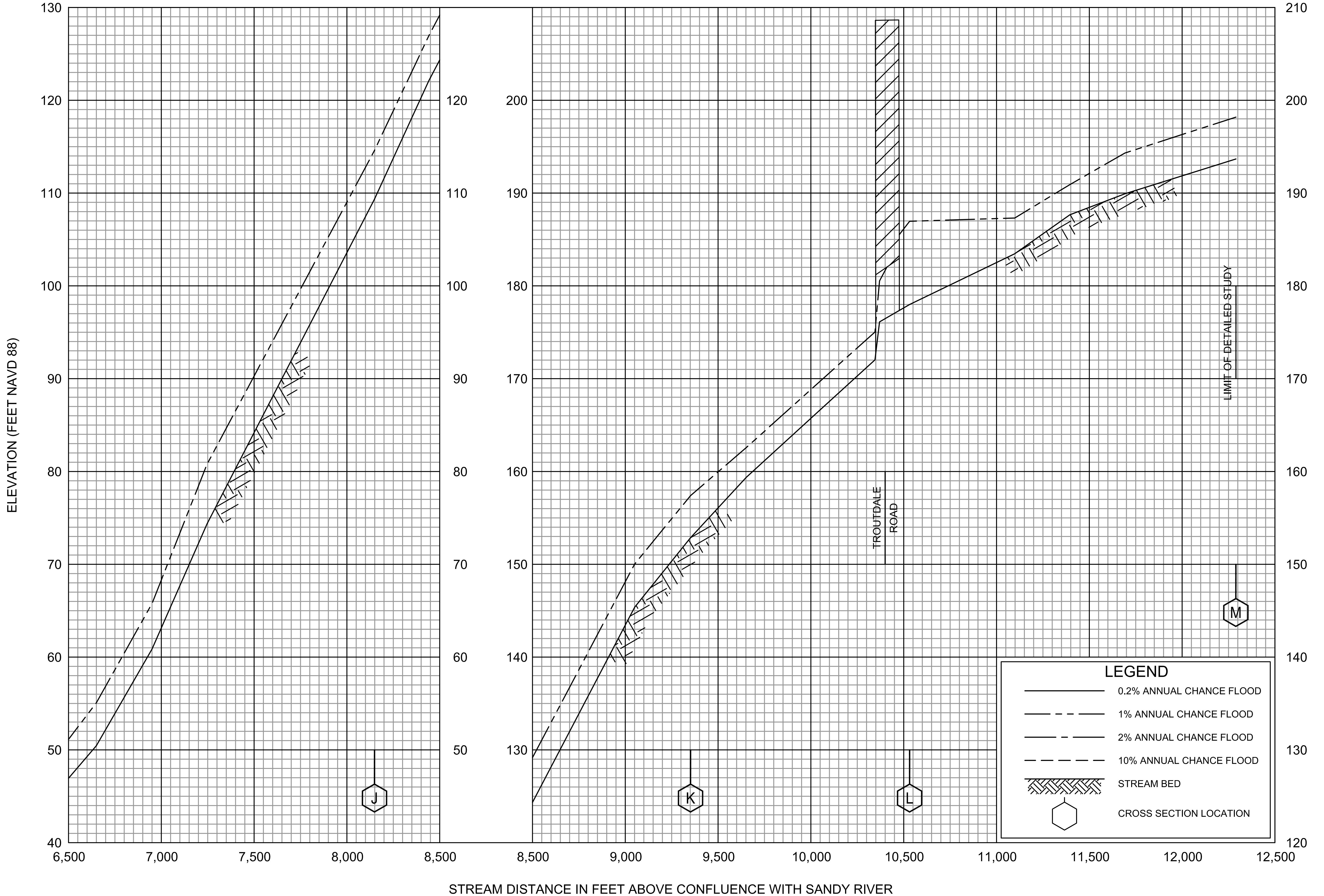
BEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

01P



FLOOD PROFILES

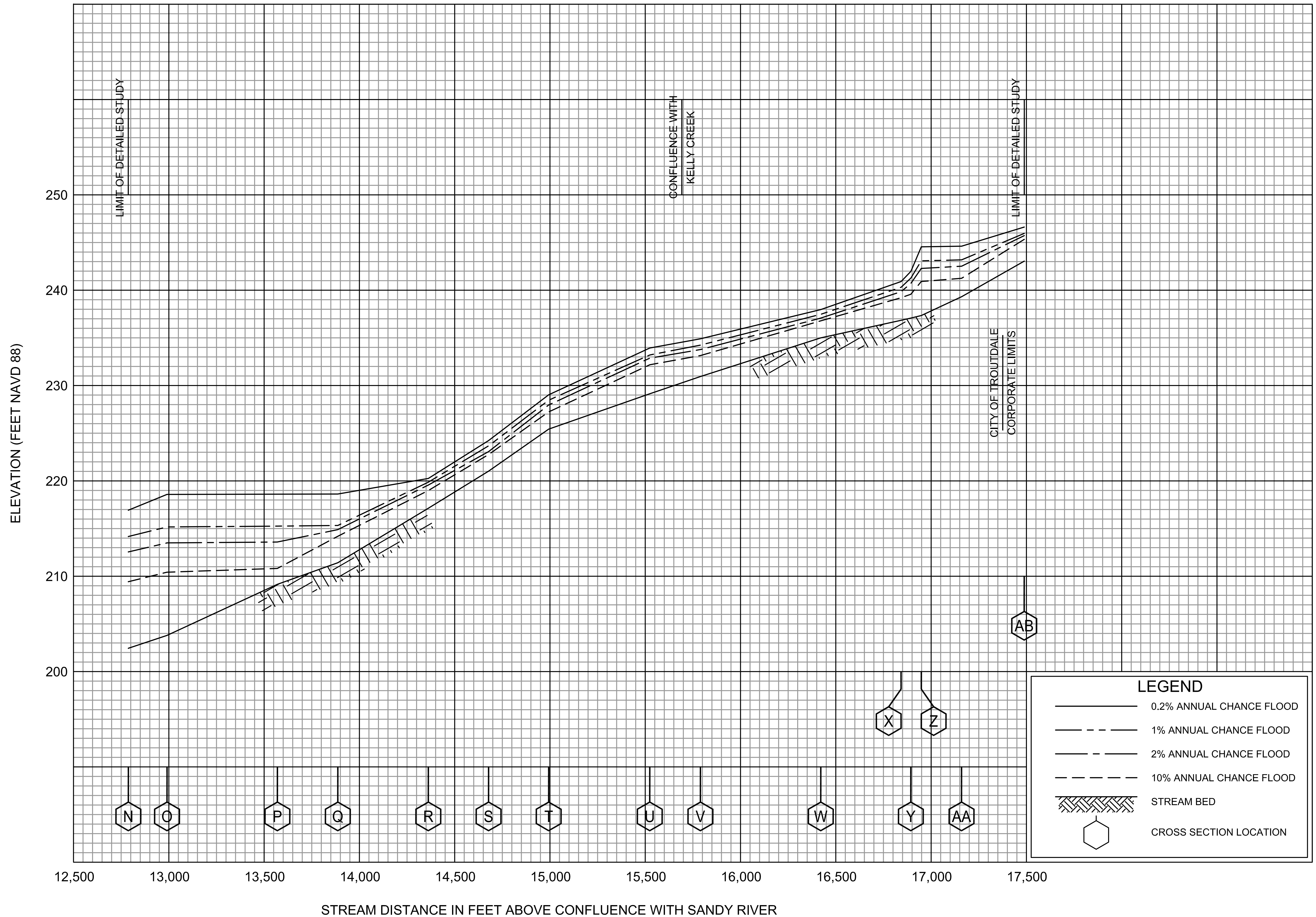
BEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

02P



FLOOD PROFILES

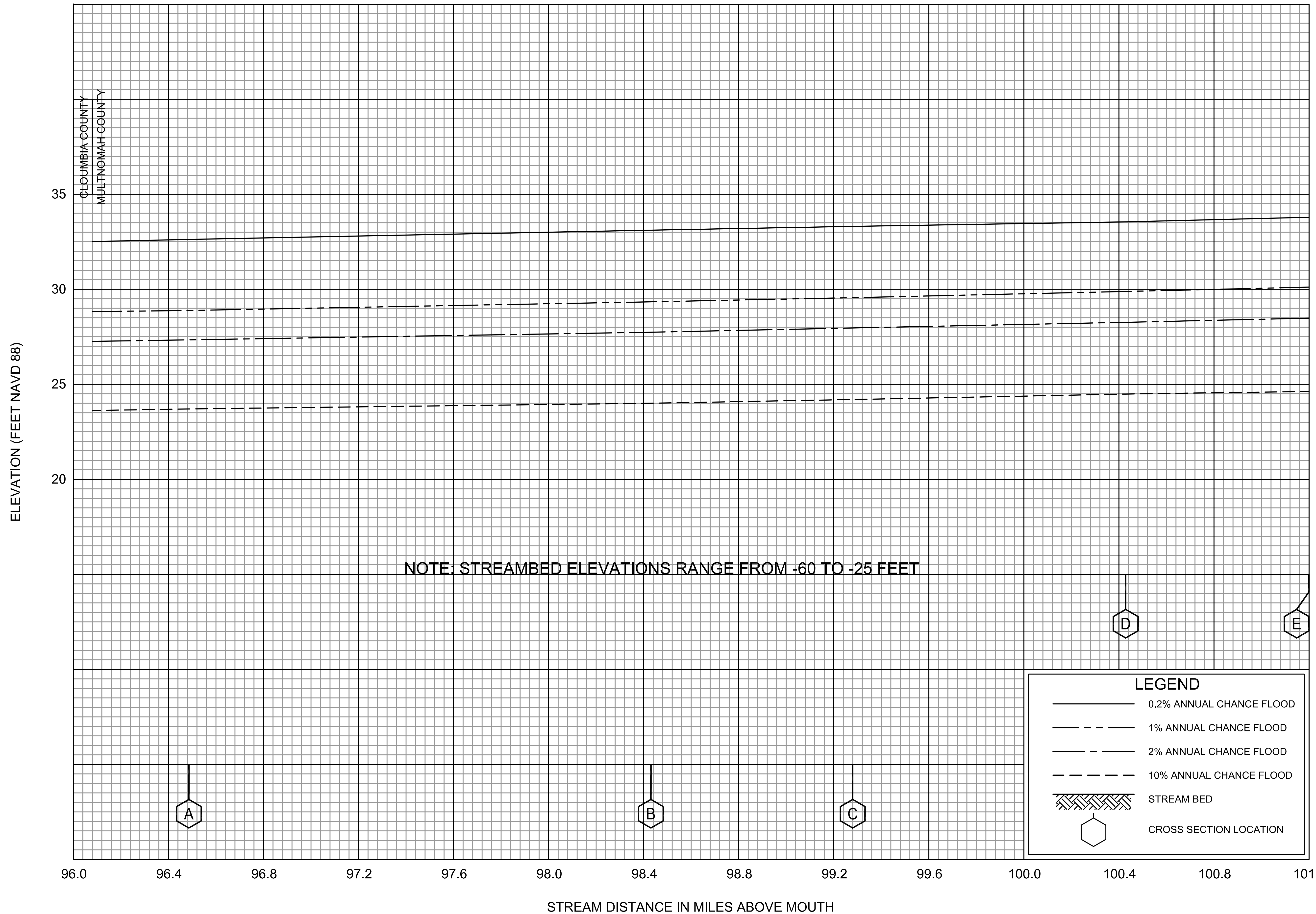
BEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

03P



FLOOD PROFILES

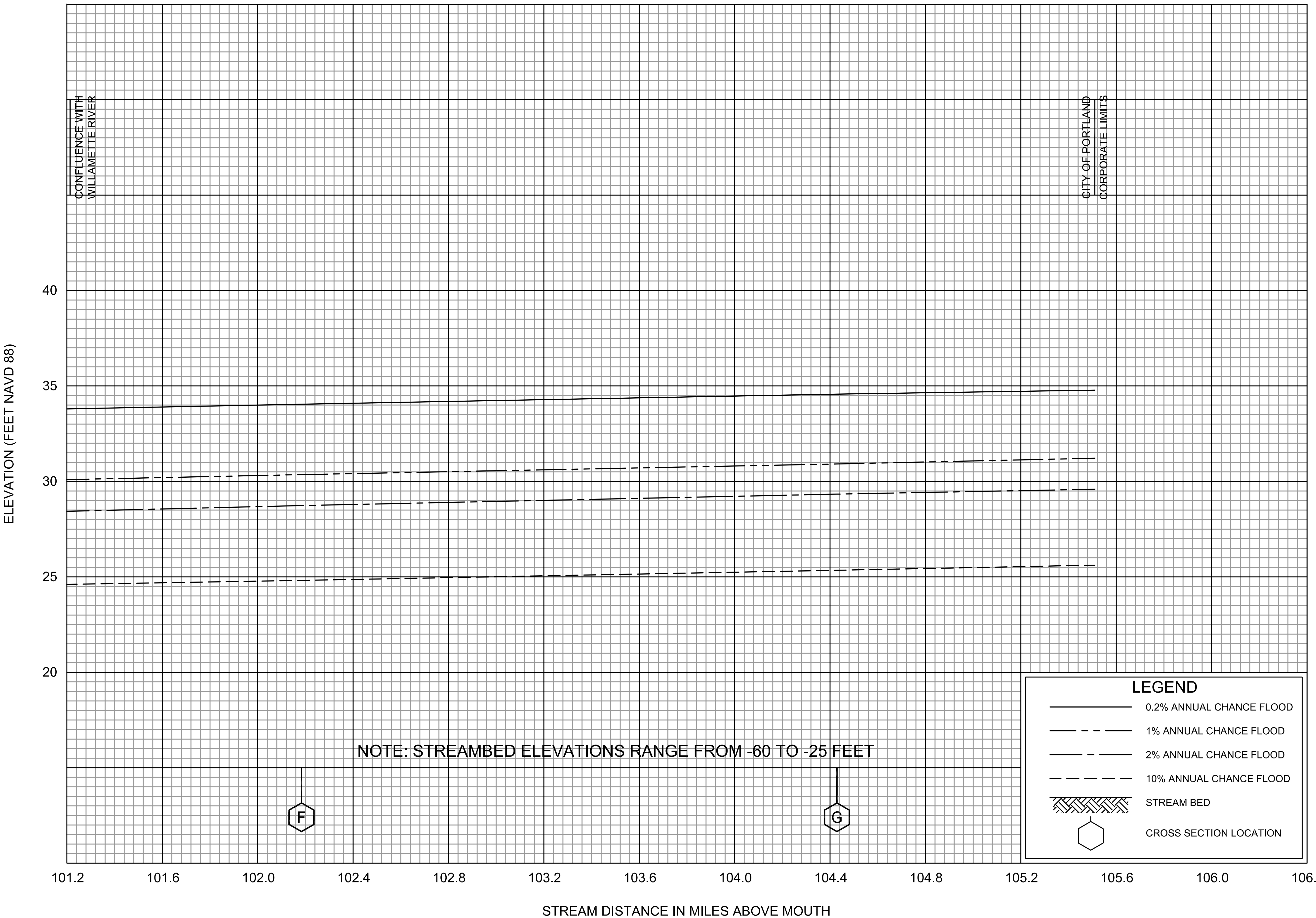
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

04P



FLOOD PROFILES

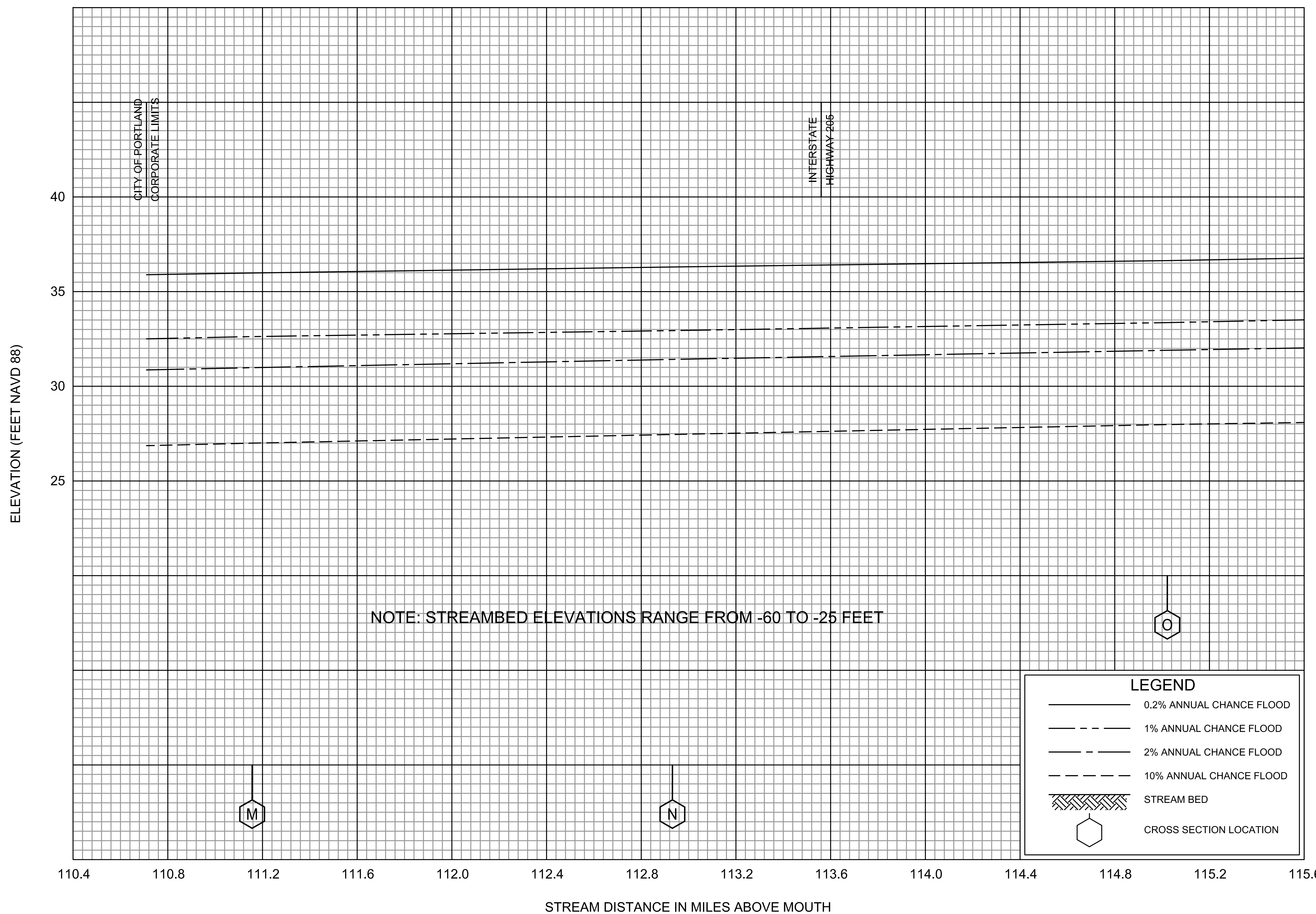
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

05P



FLOOD PROFILES

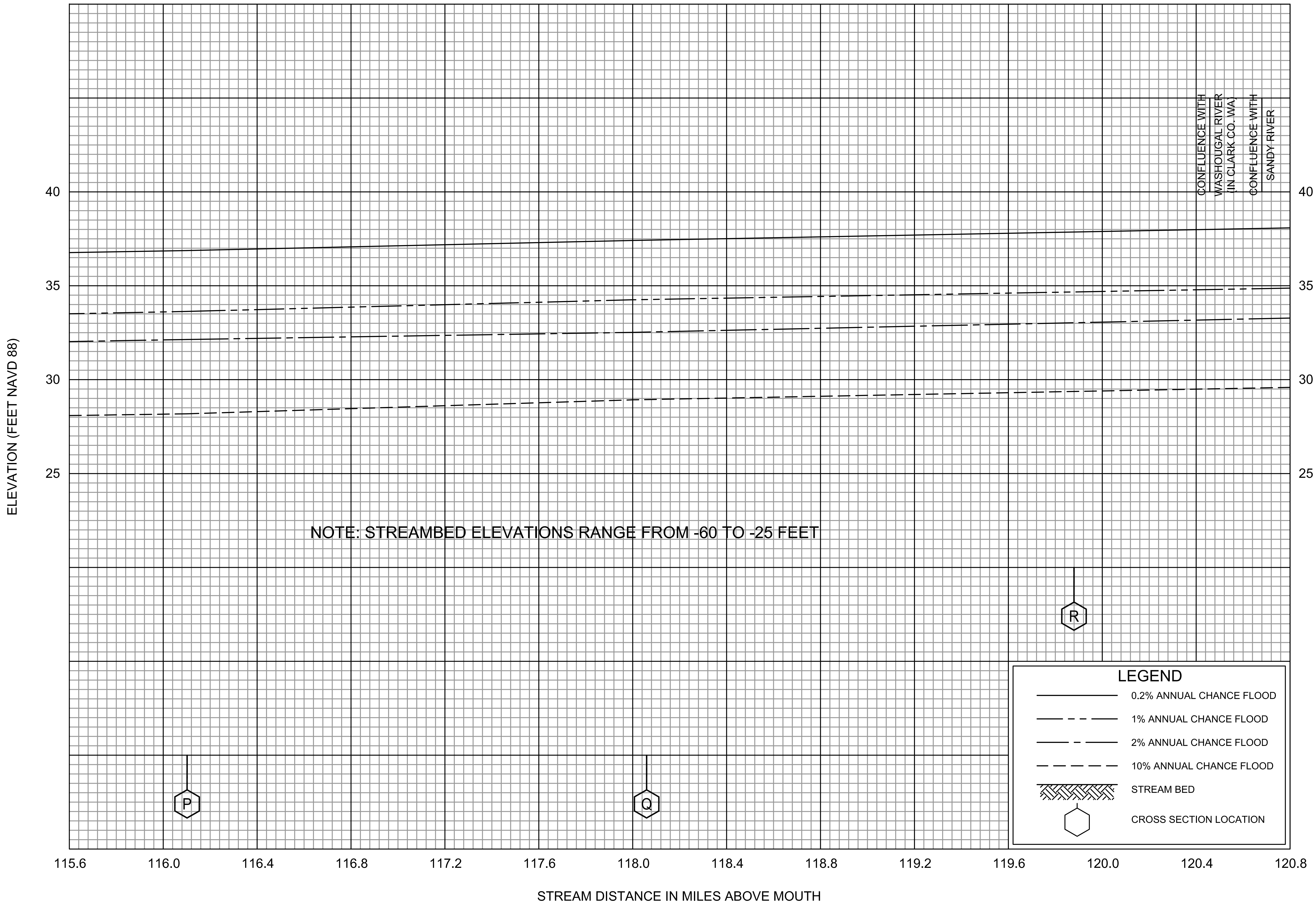
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

06P



FLOOD PROFILES

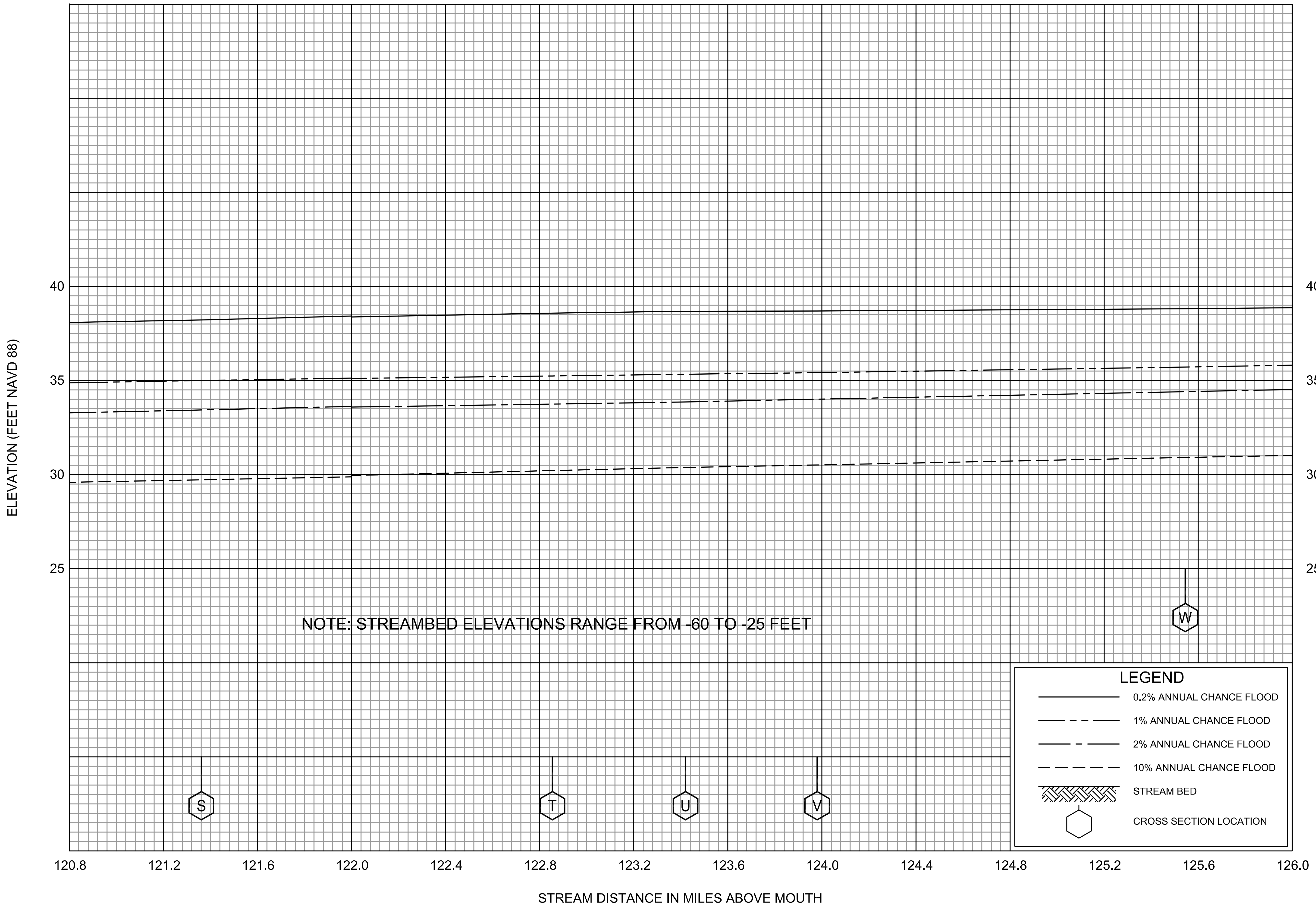
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

07P



FLOOD PROFILES

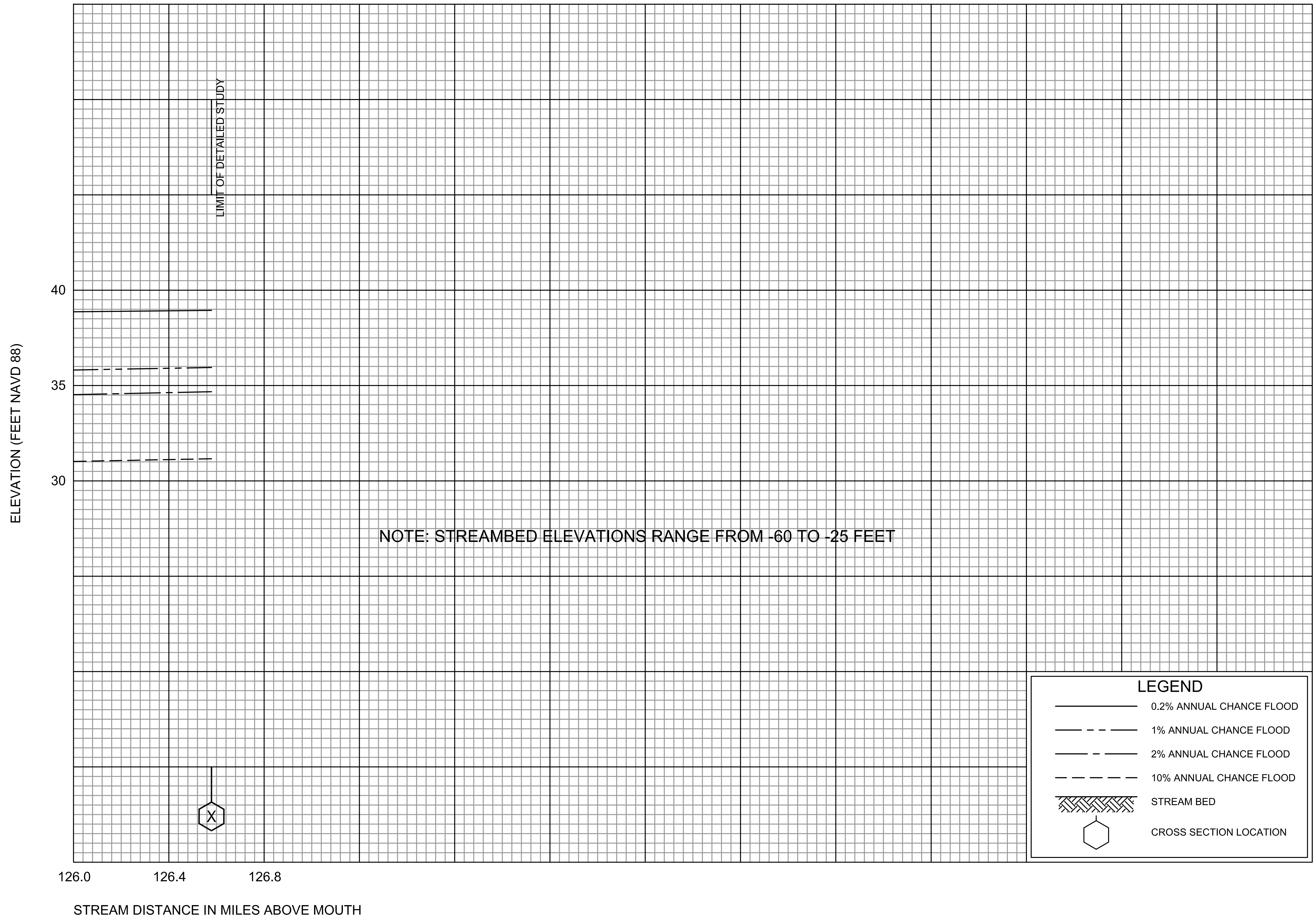
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

08P



FLOOD PROFILES

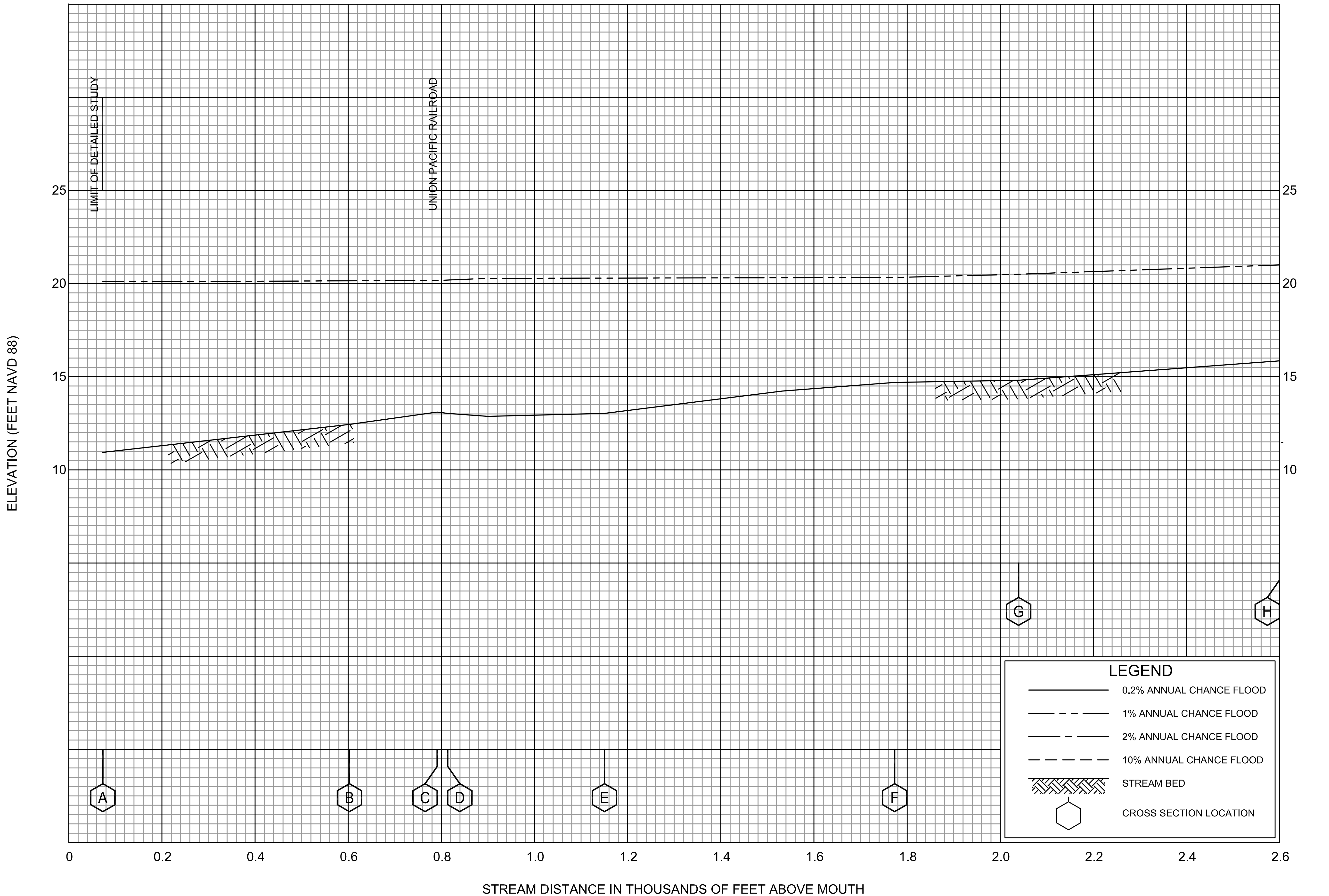
COLUMBIA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

09P



FLOOD PROFILES

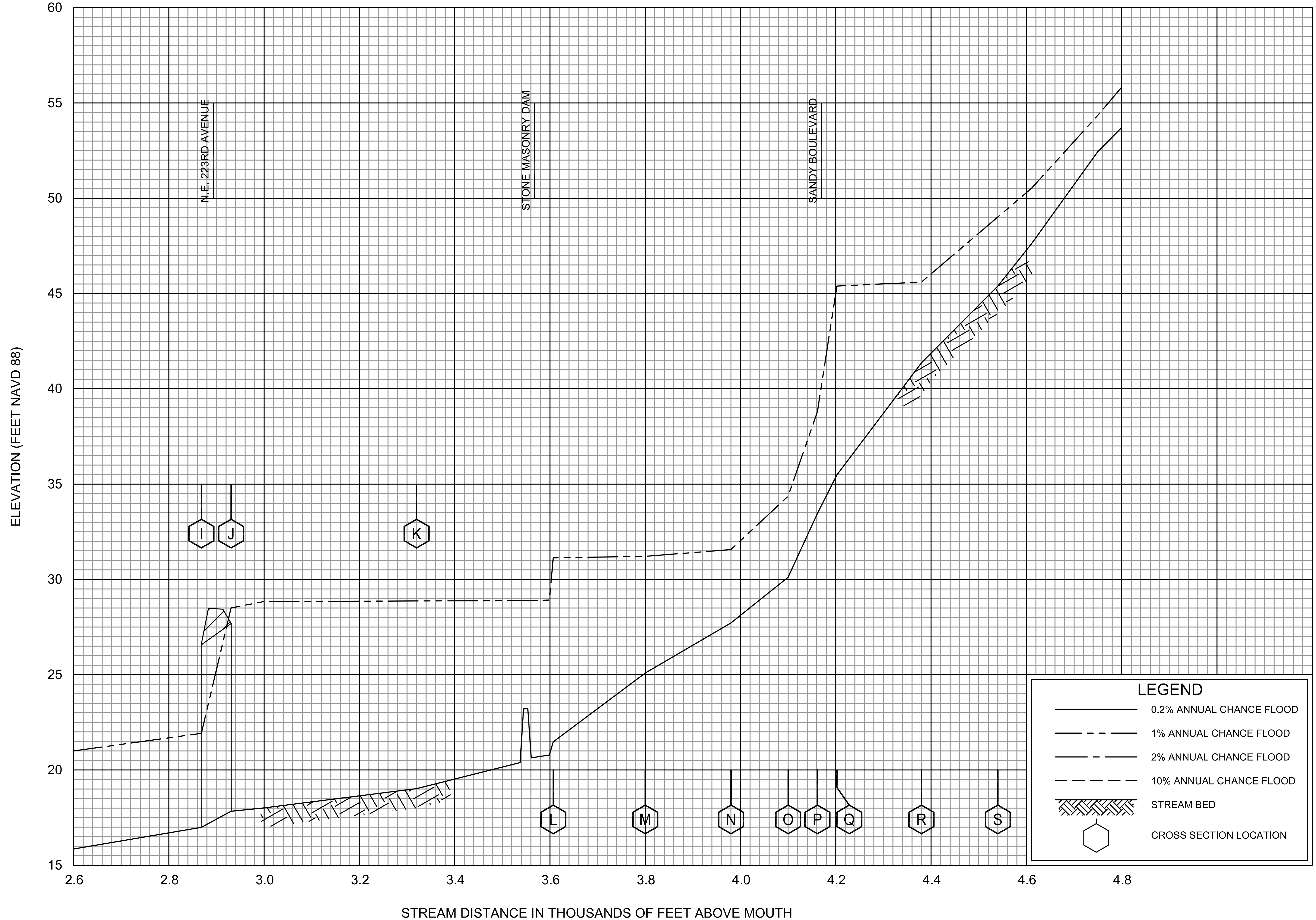
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

10P



FLOOD PROFILES

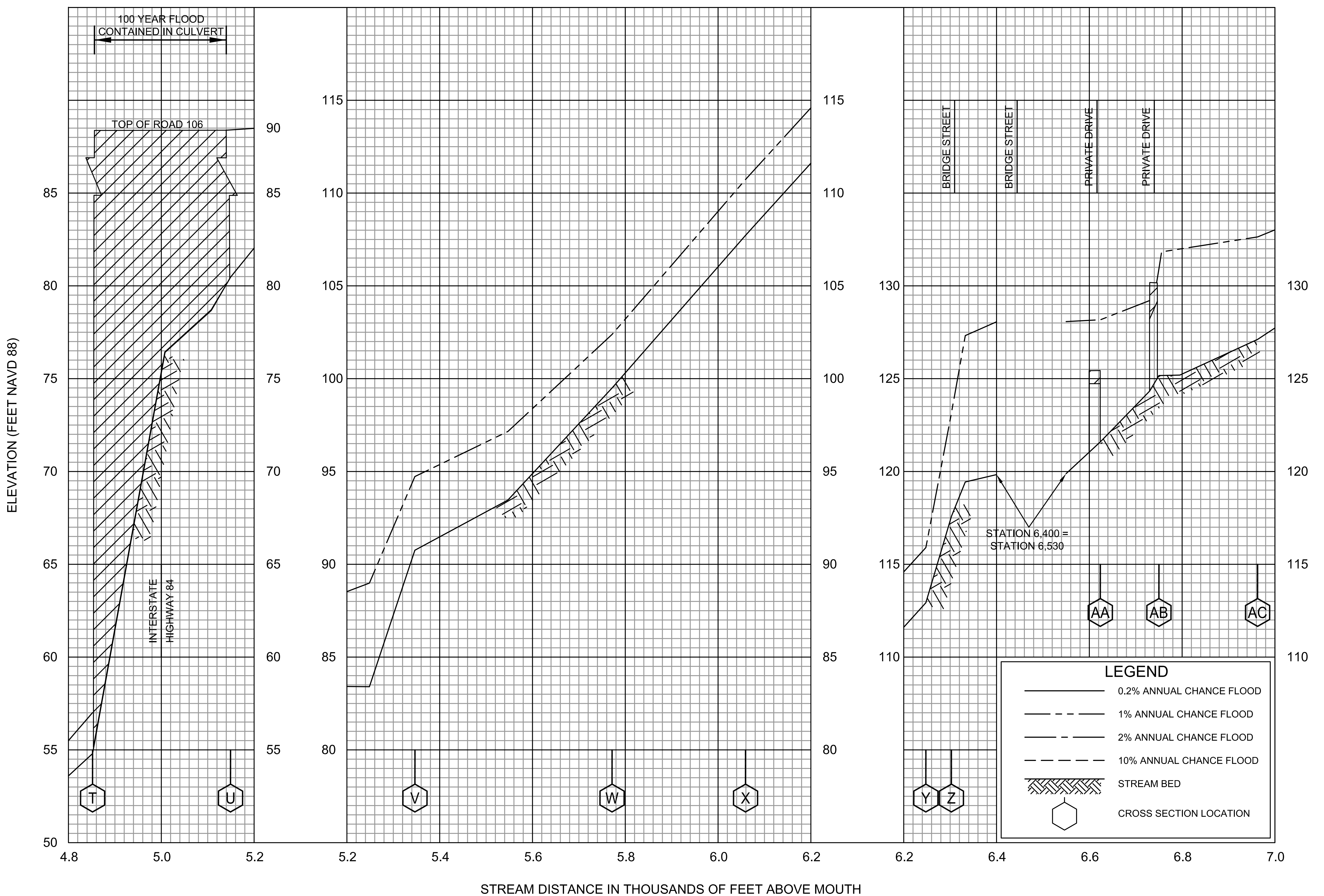
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

11P



FLOOD PROFILES

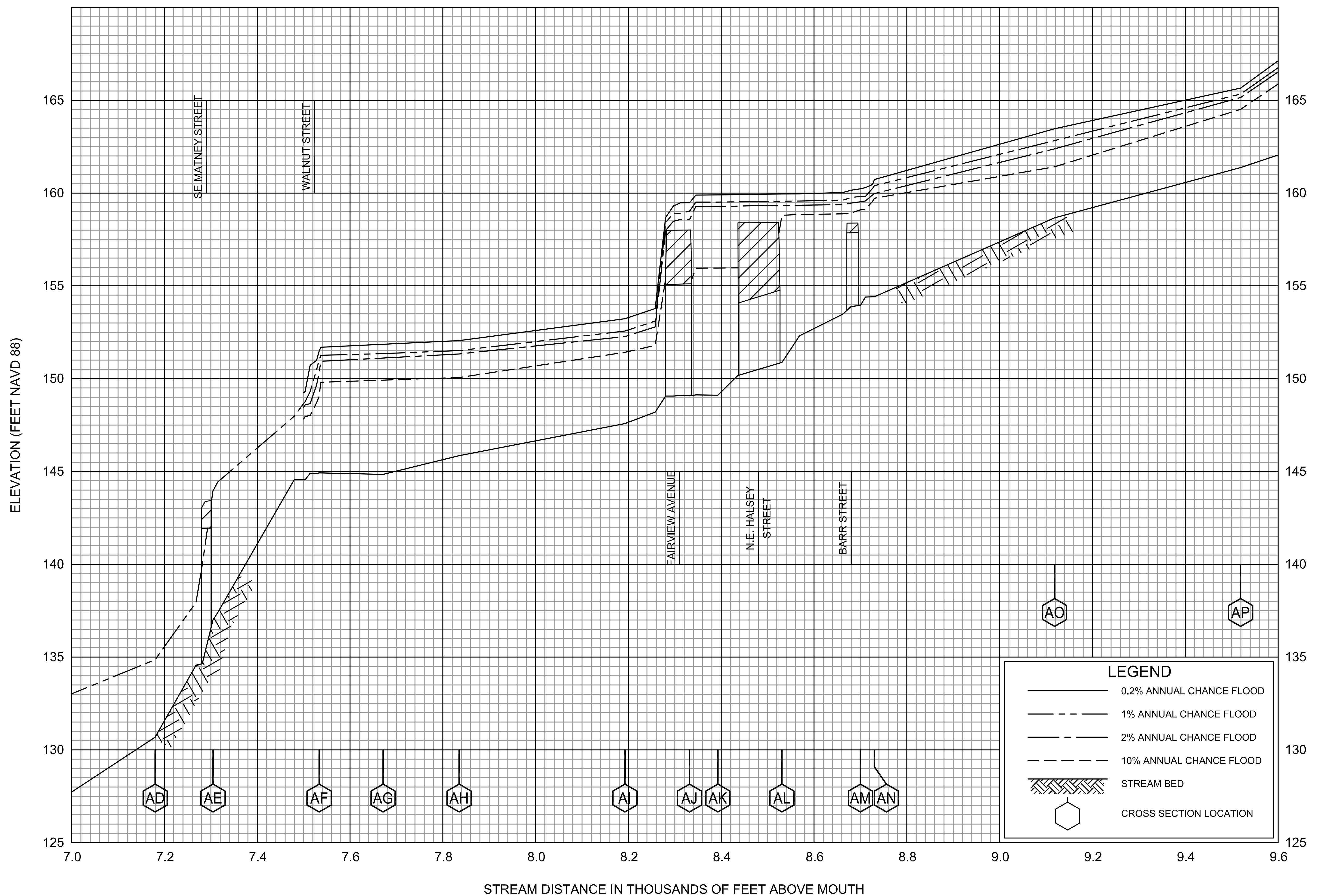
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

12P



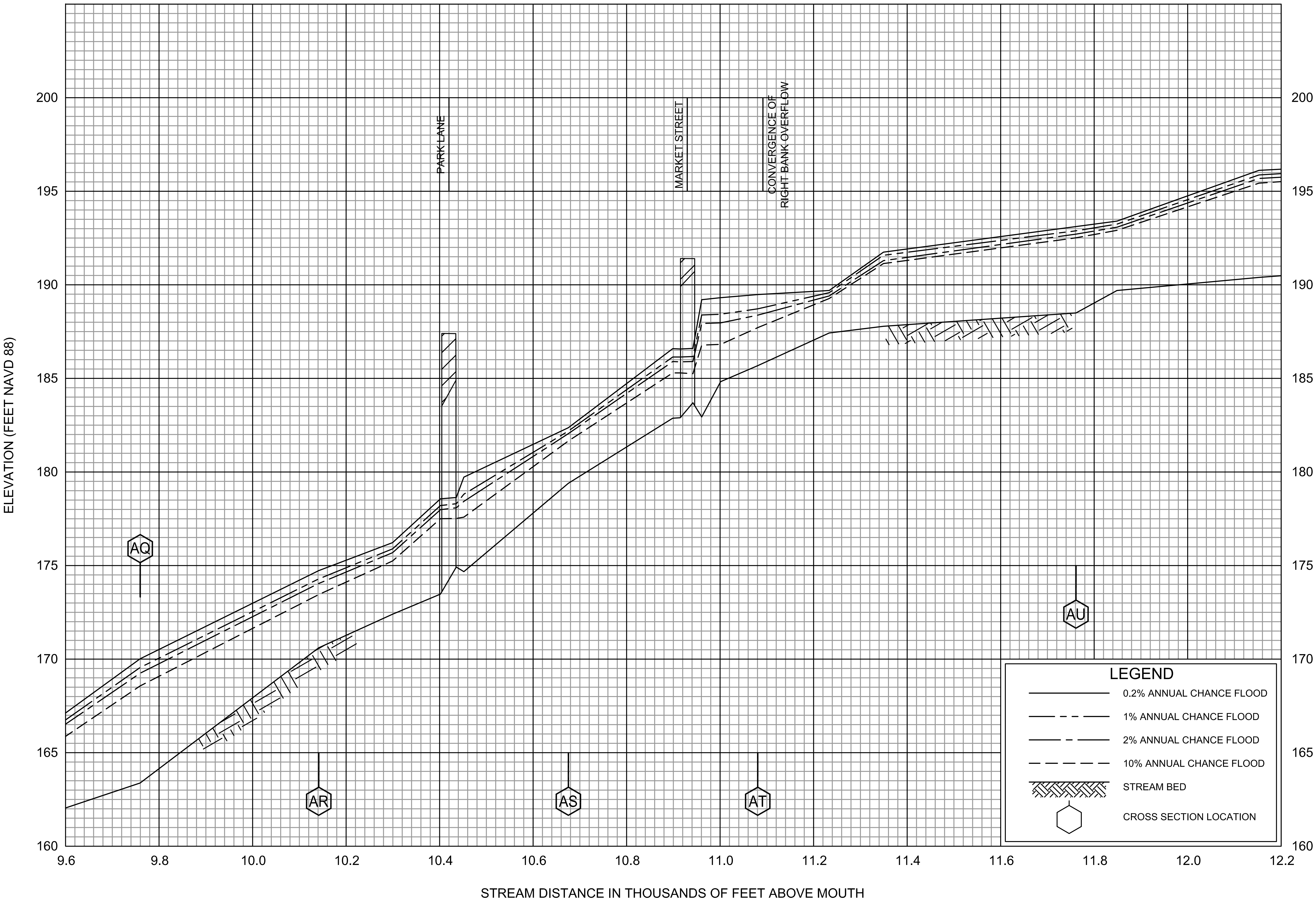
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



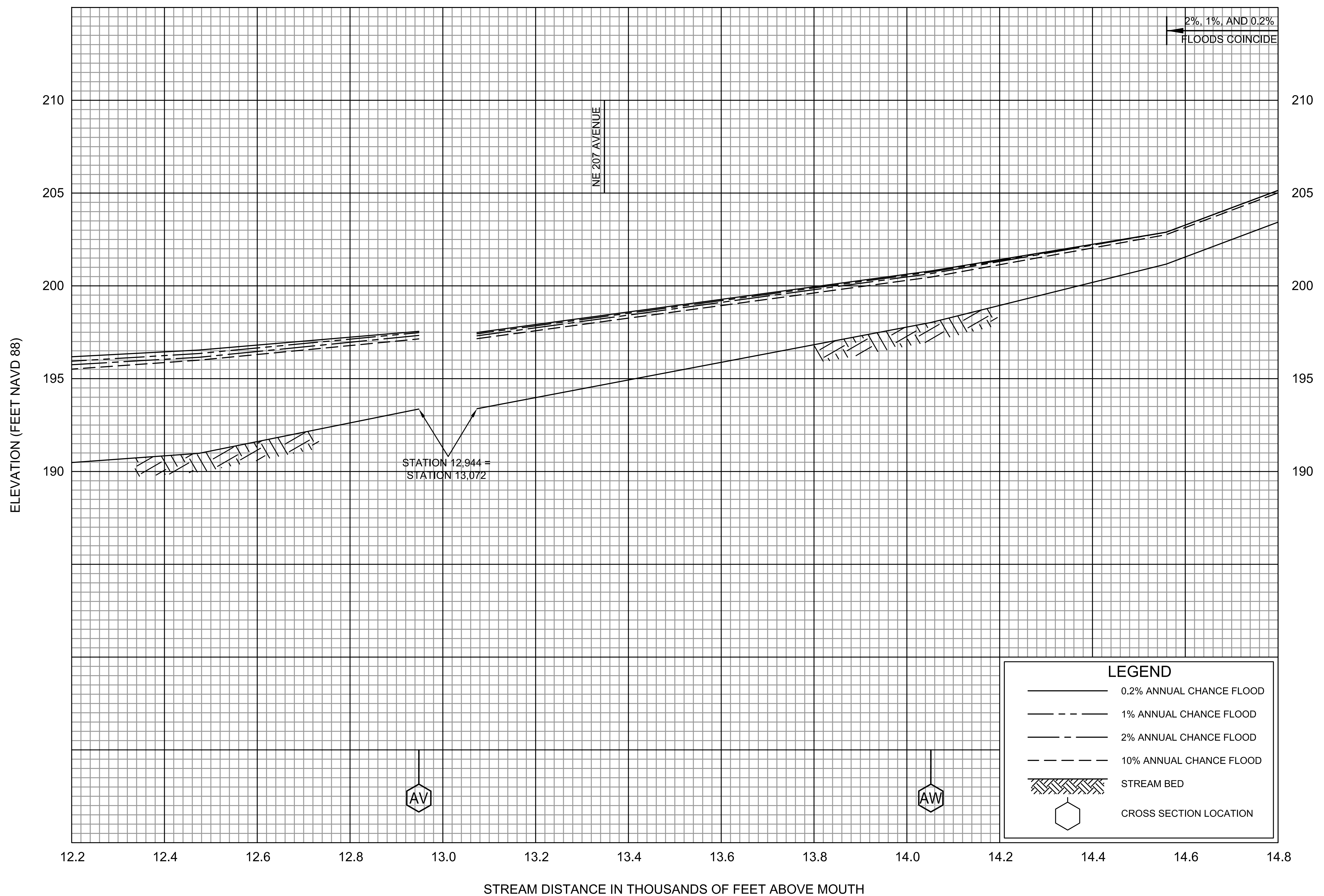
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



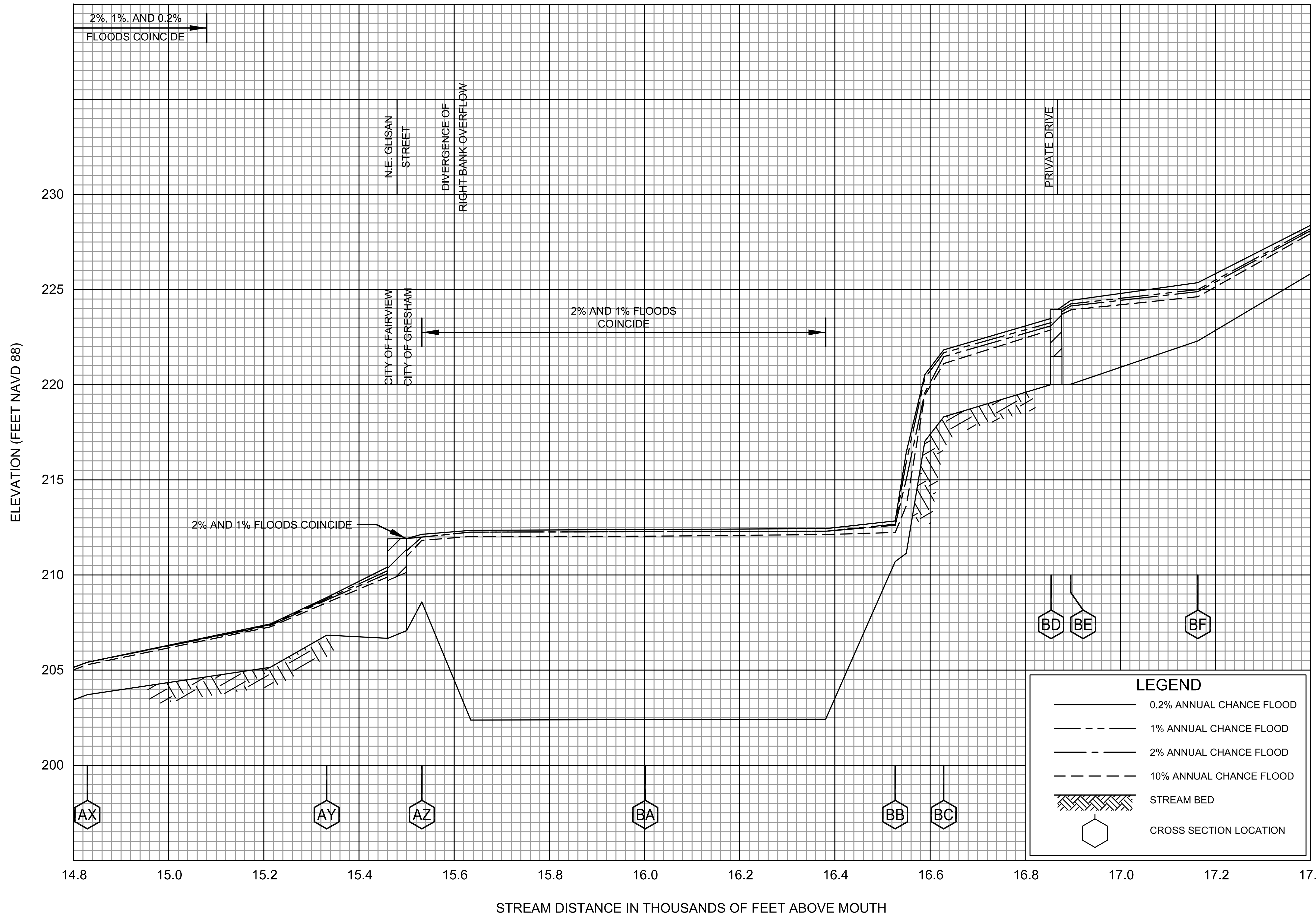
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

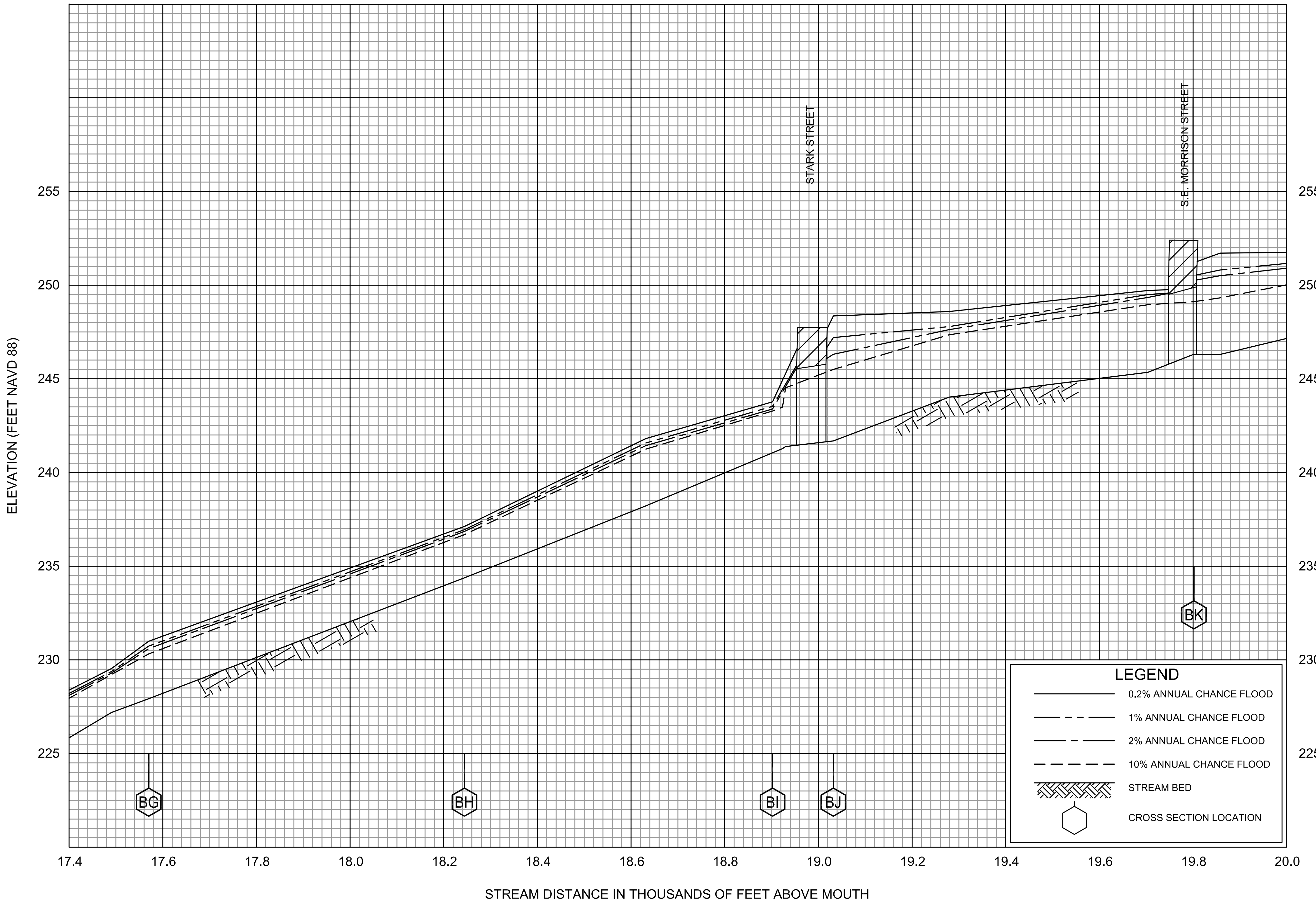
AND INCORPORATED AREAS



FLOOD PROFILES
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
MULTNOMAH CO, OR
AND INCORPORATED AREAS

16P



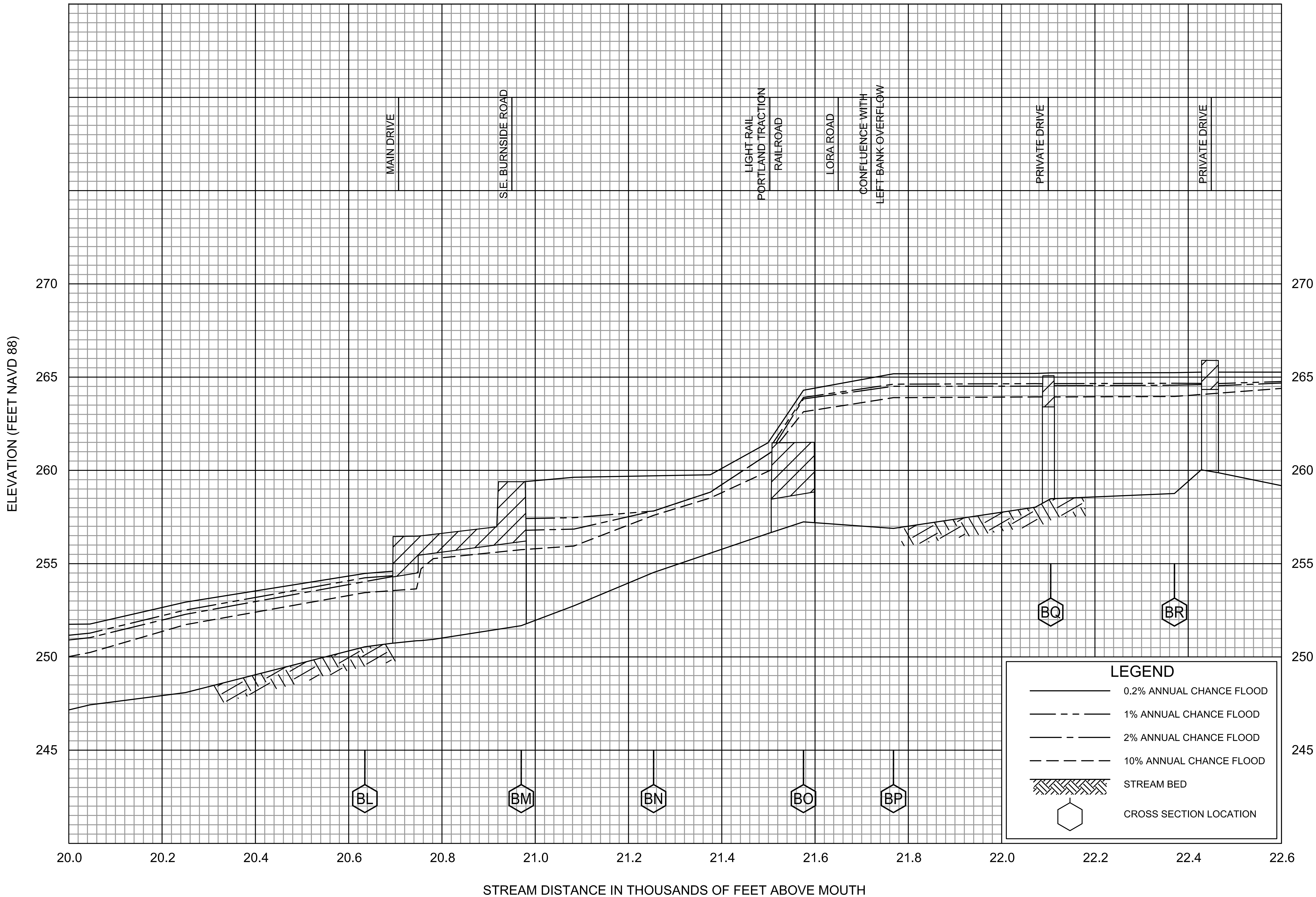
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

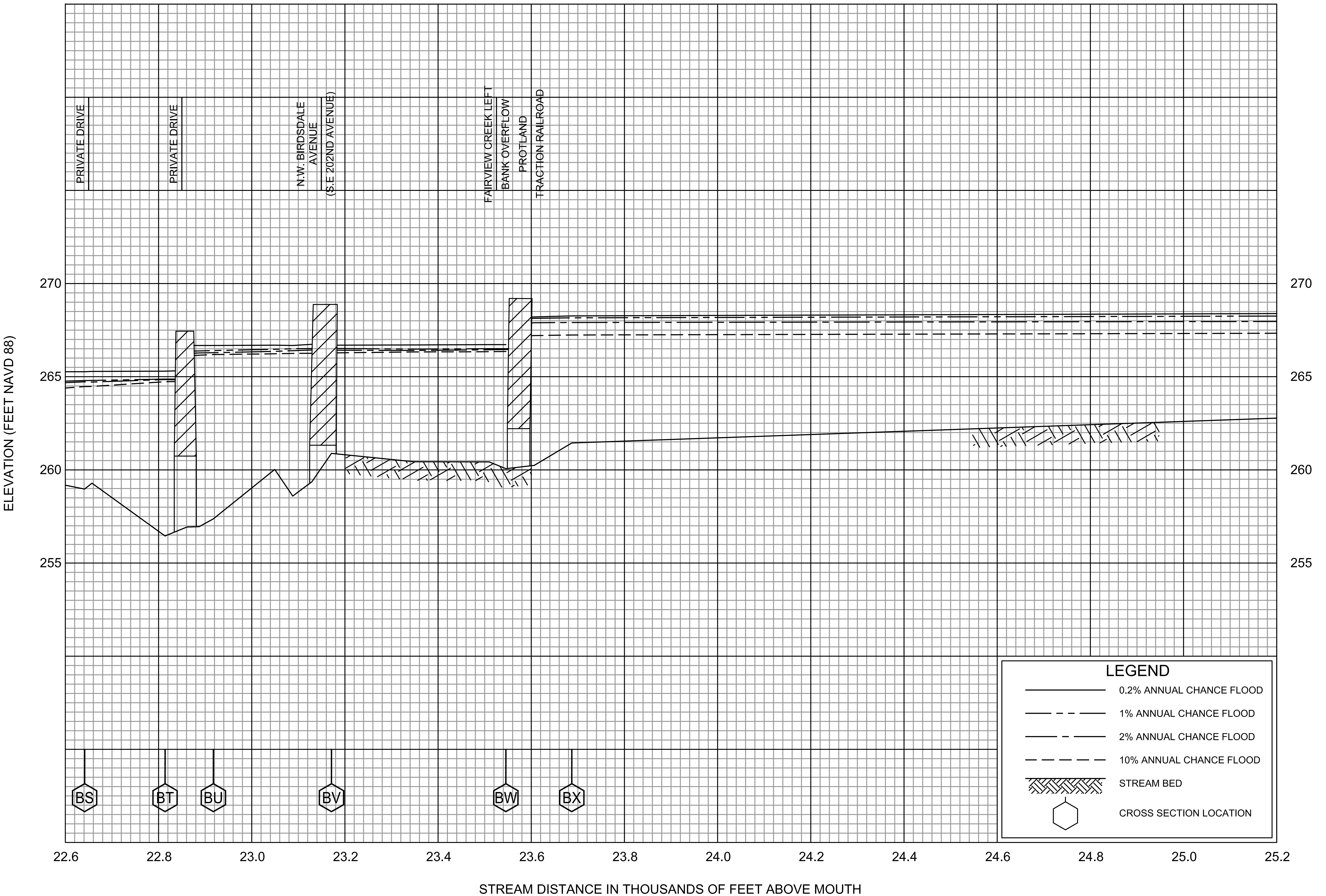
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

18P



FLOOD PROFILES

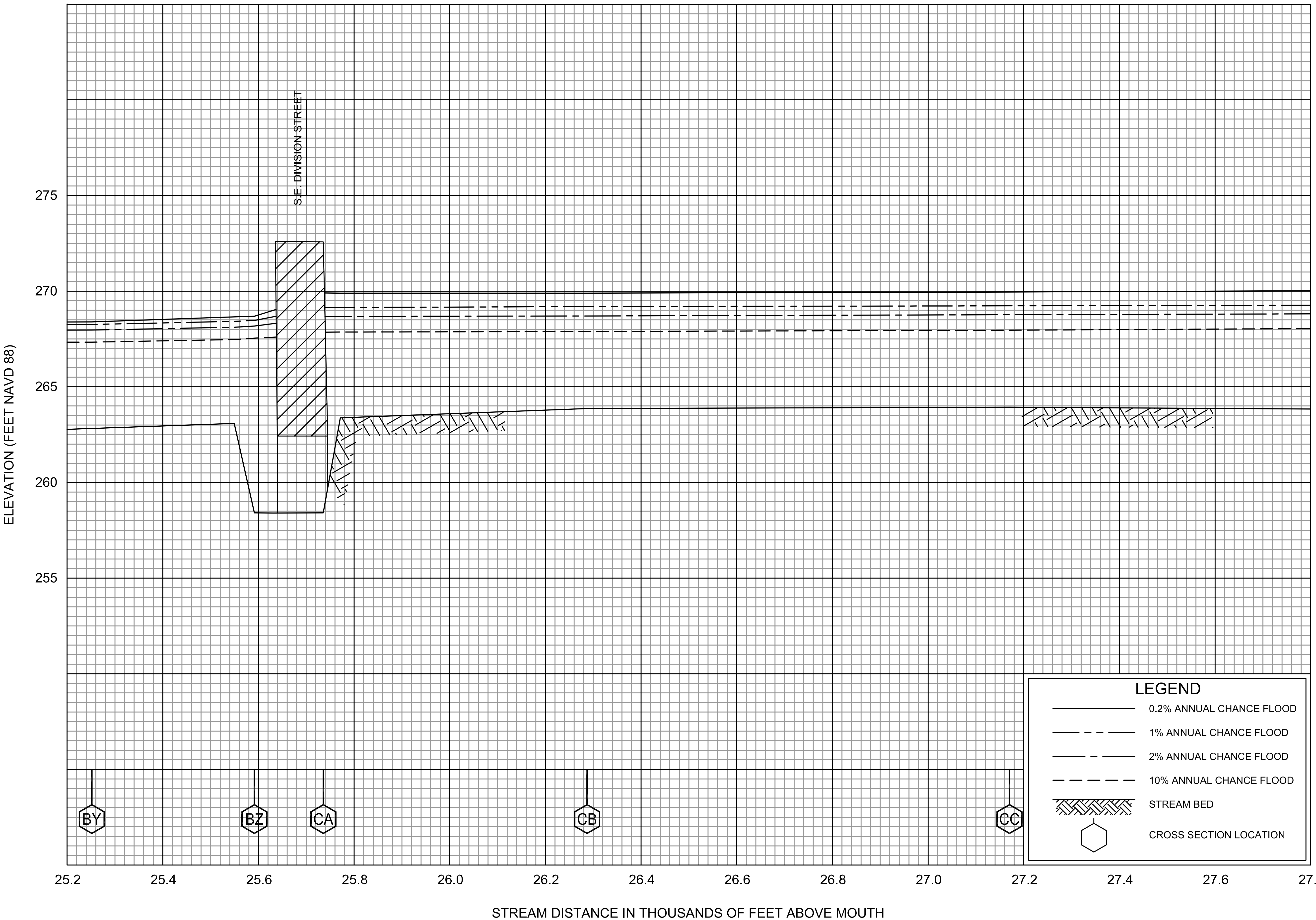
FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

19P



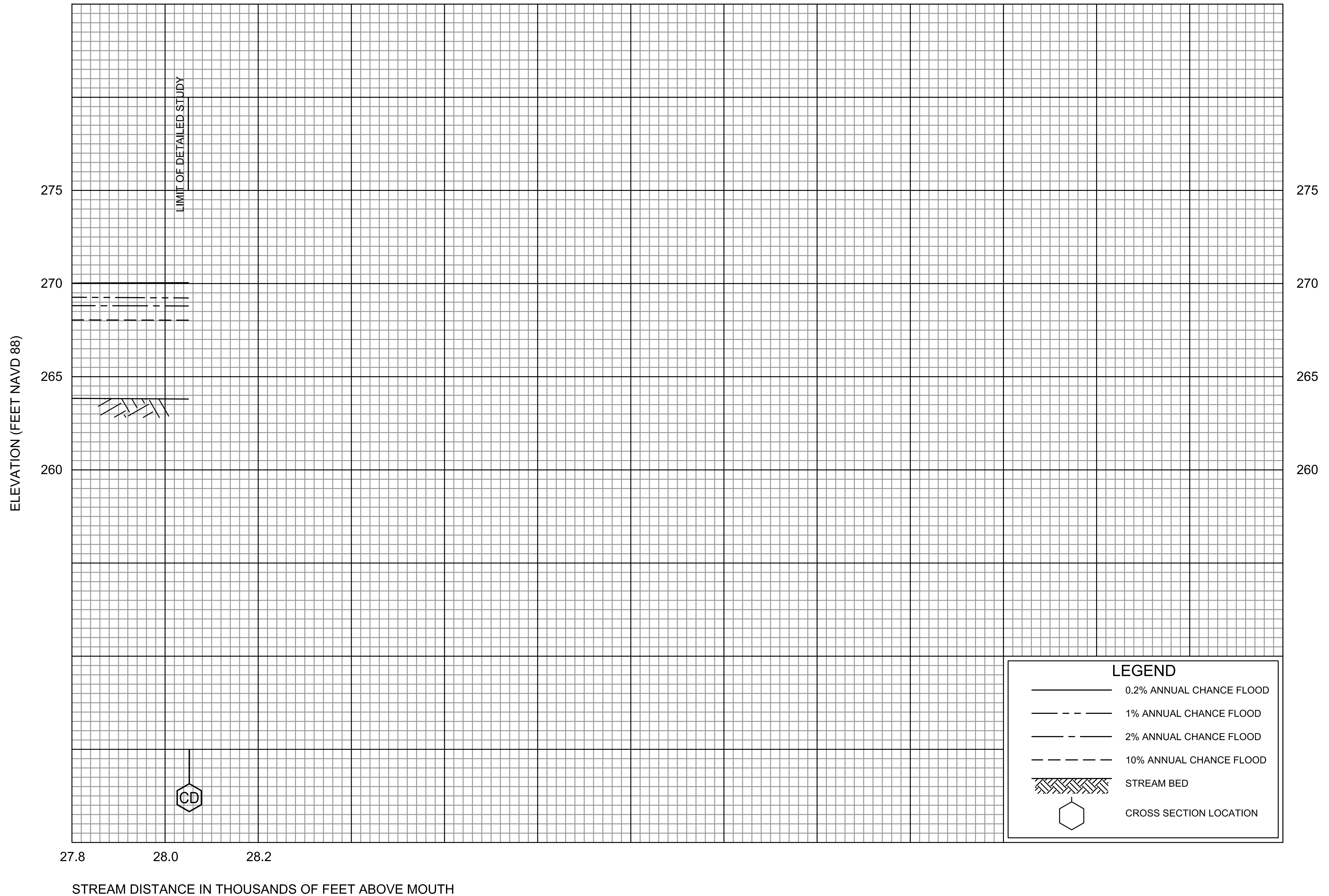
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



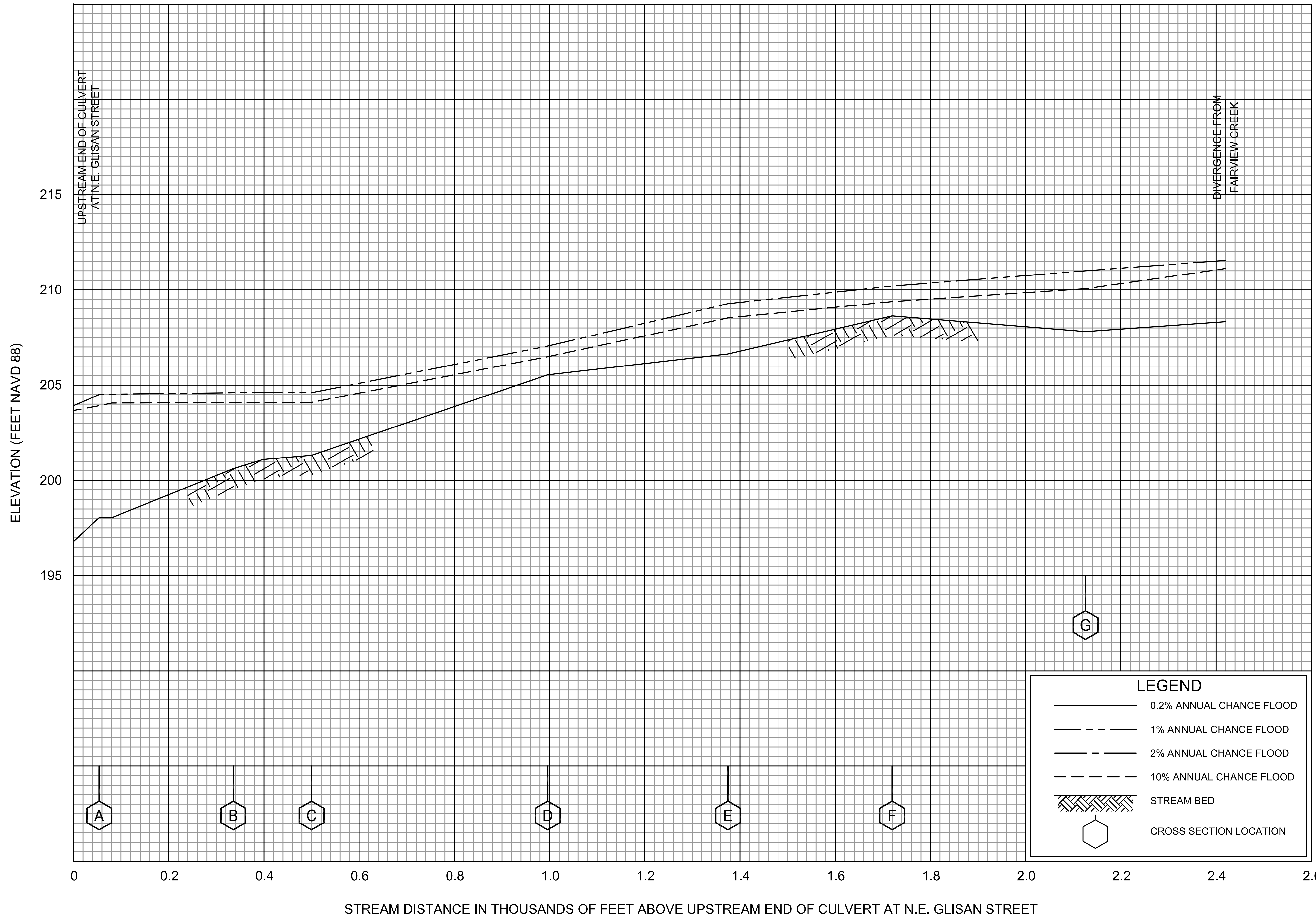
FLOOD PROFILES

FAIRVIEW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



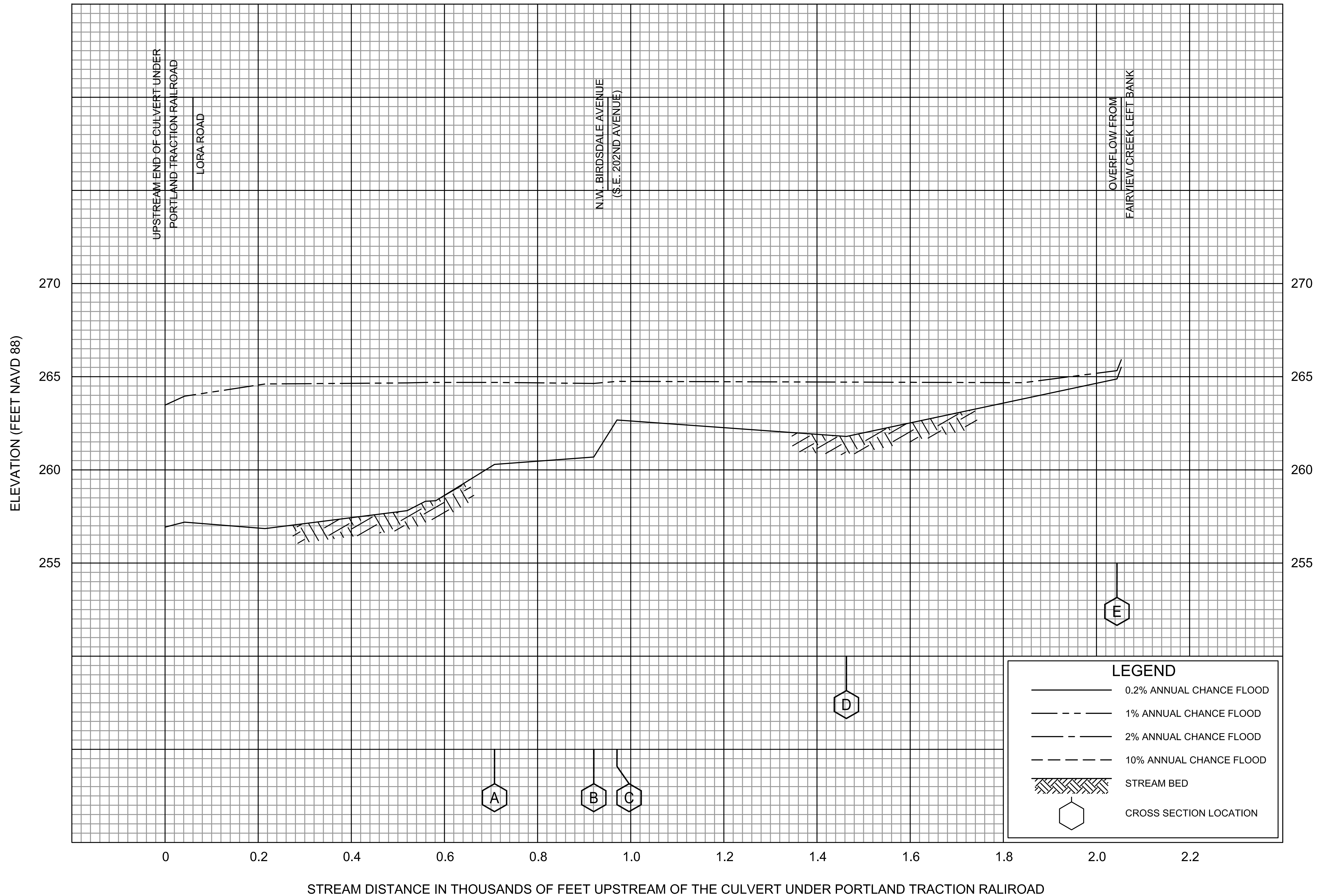
FLOOD PROFILES

FAIRVIEW CREEK - (RIGHT BANK OVERFLOW ALONG N.E. GLISAN STREET)

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR AND INCORPORATED AREAS

22P



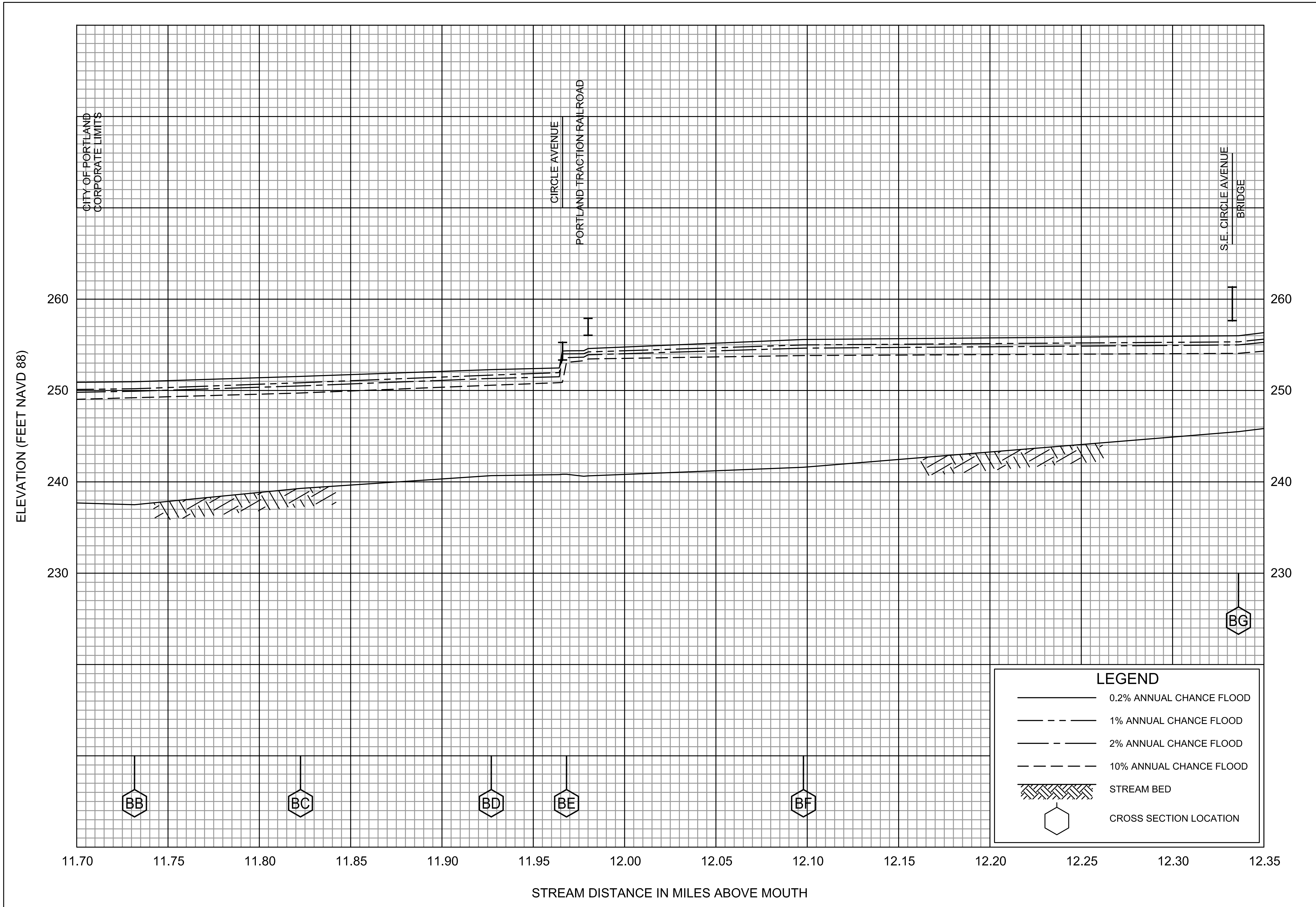
FLOOD PROFILES

FAIRVIEW CREEK - (LEFT BANK OVERFLOW ALONG BIRDSDALE AVENUE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



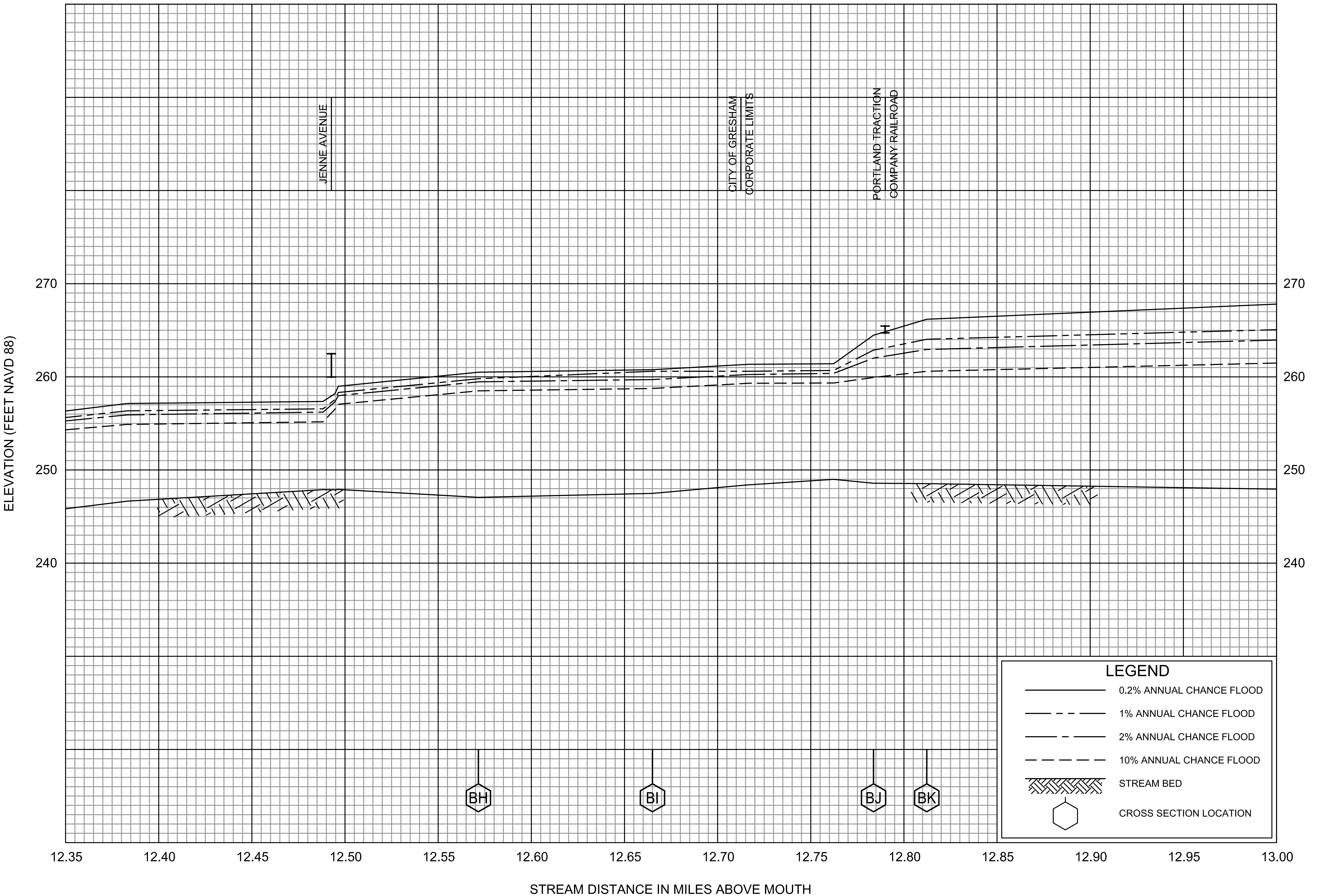
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



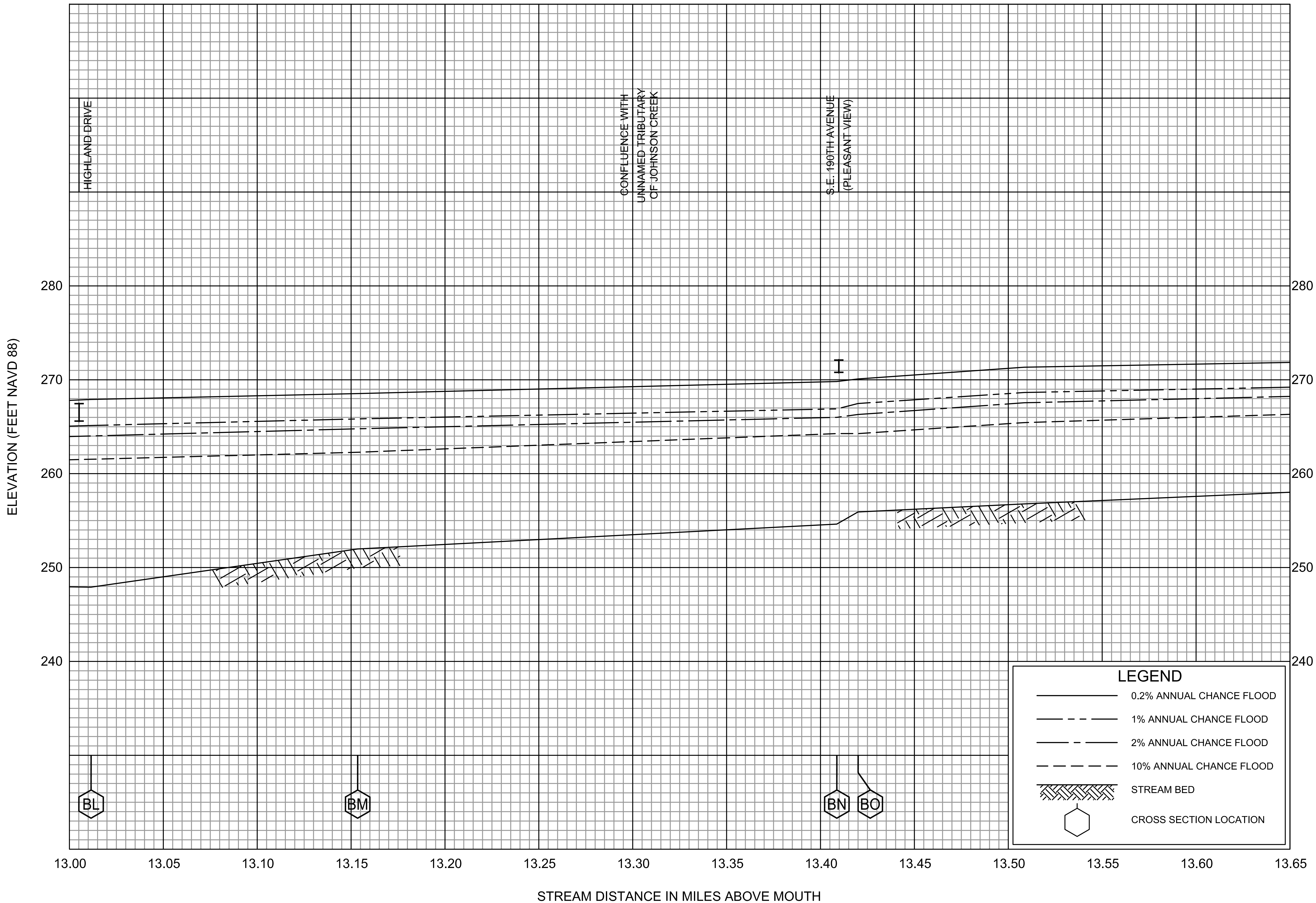
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

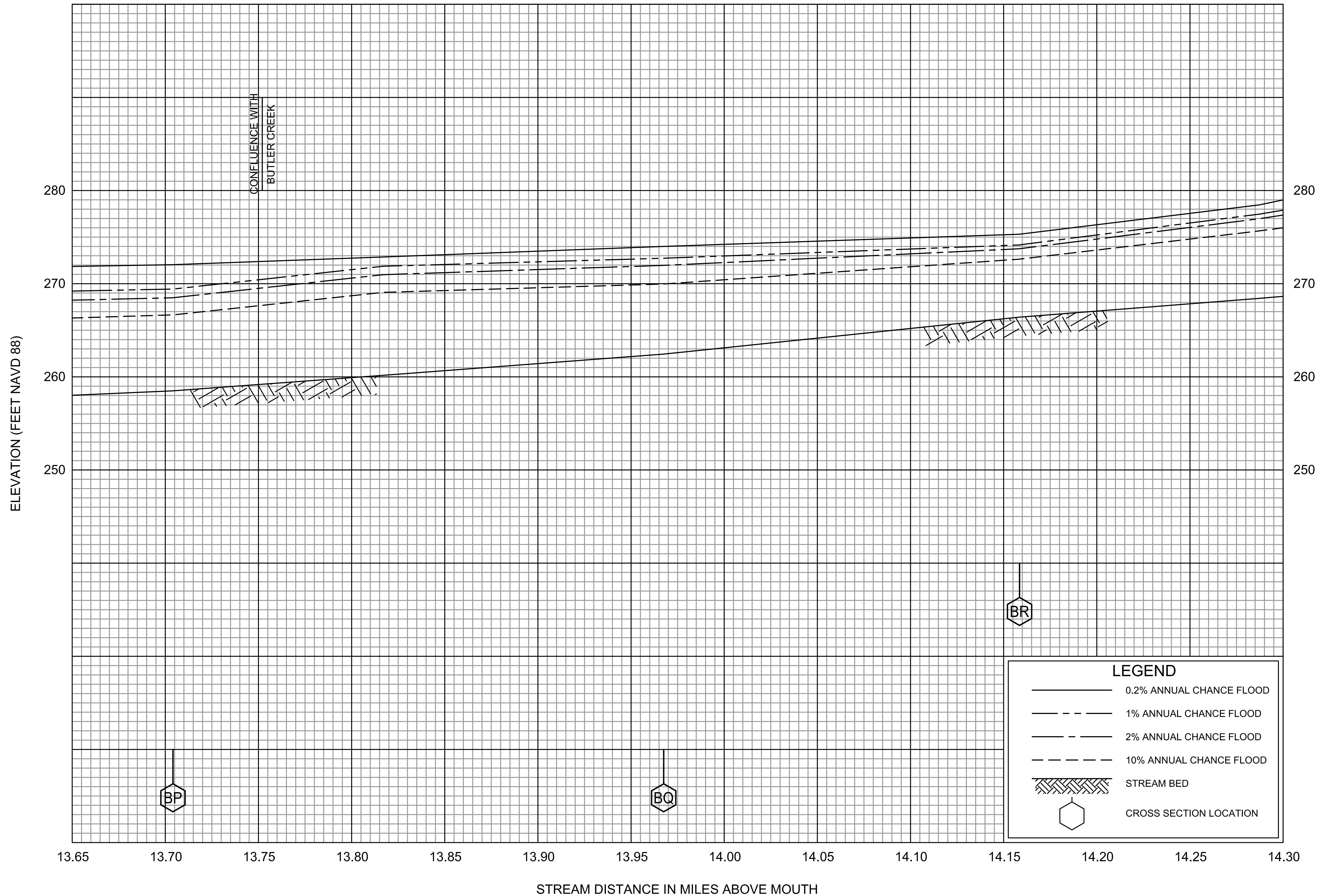
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

26P



FLOOD PROFILES

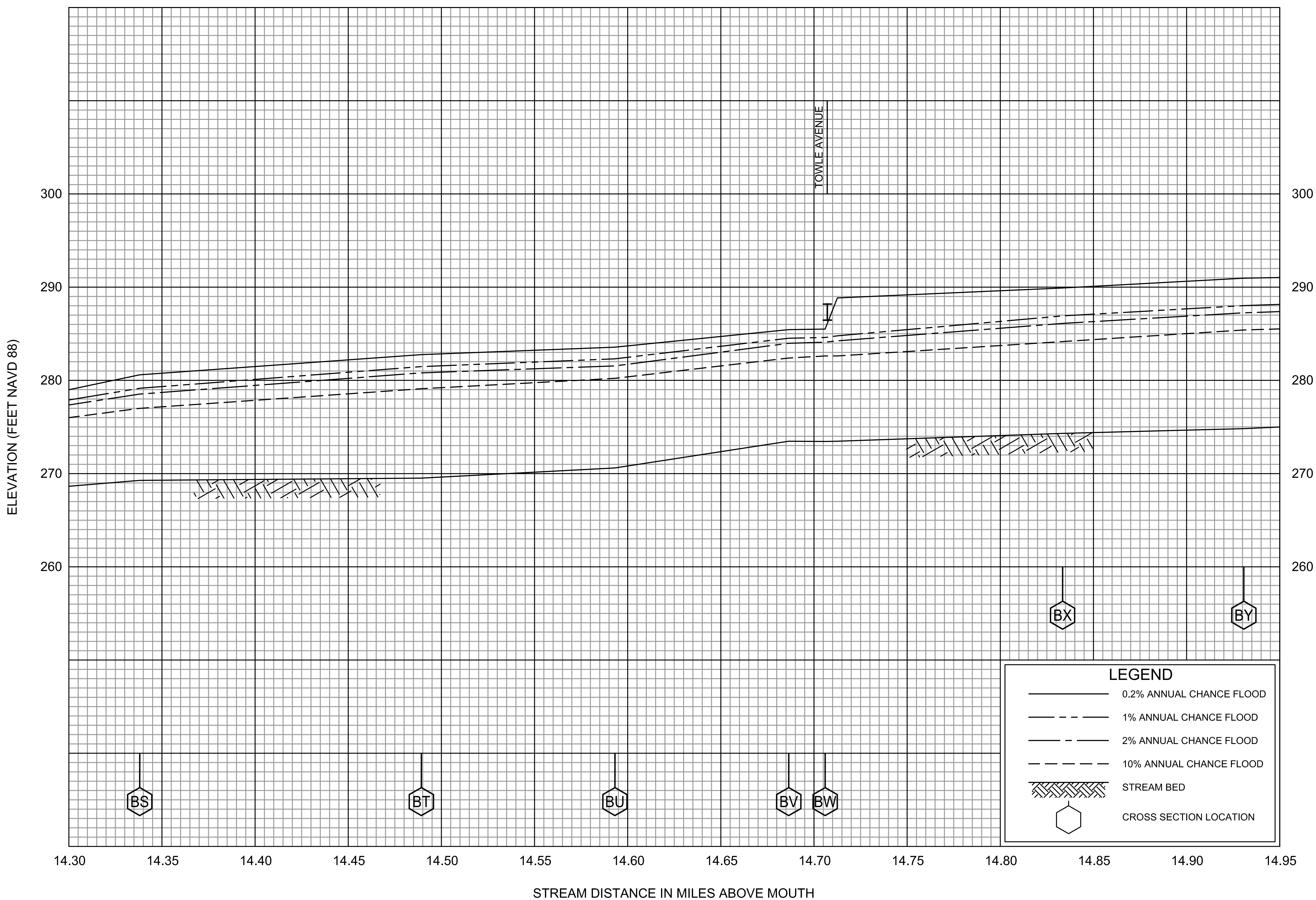
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

27P



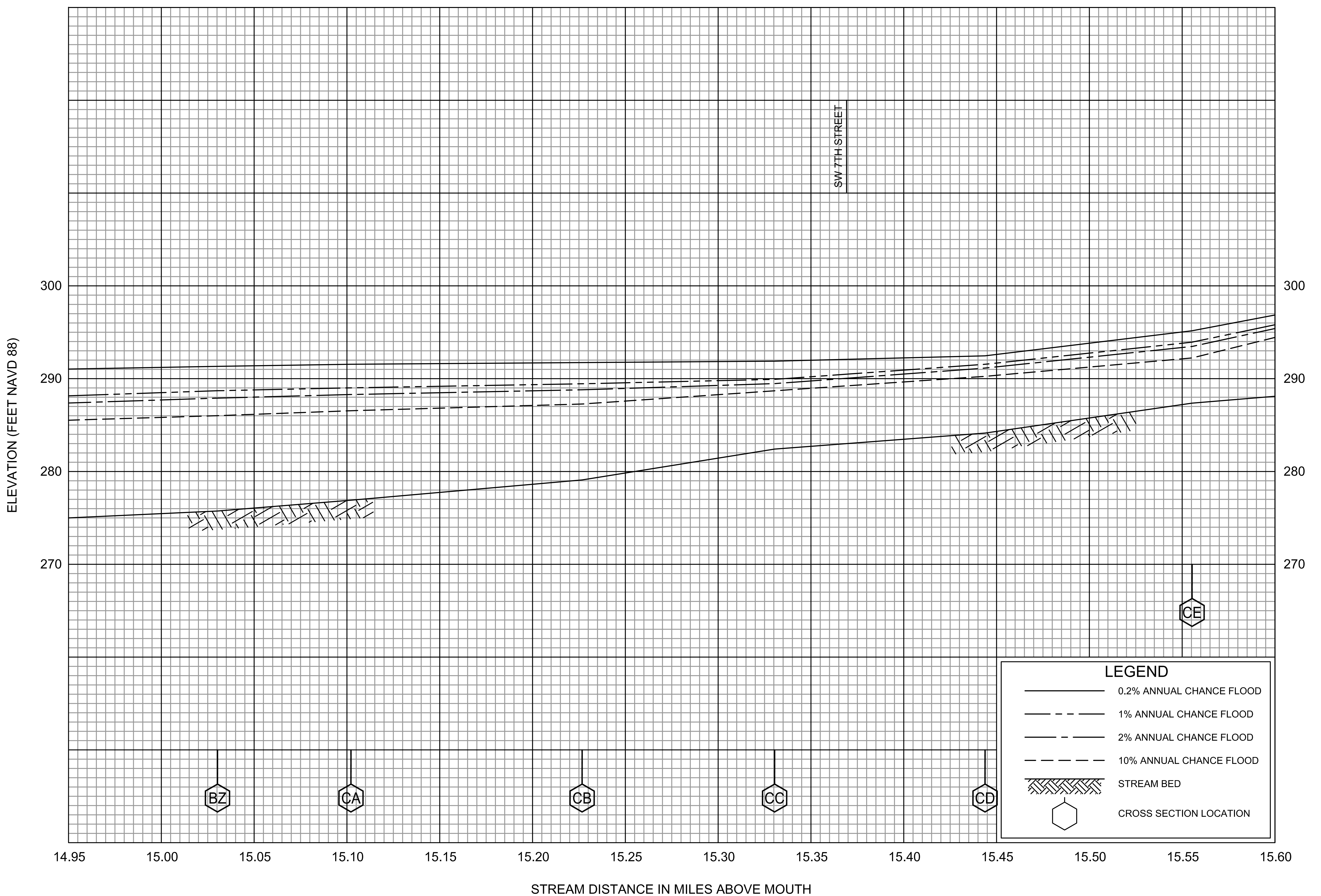
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

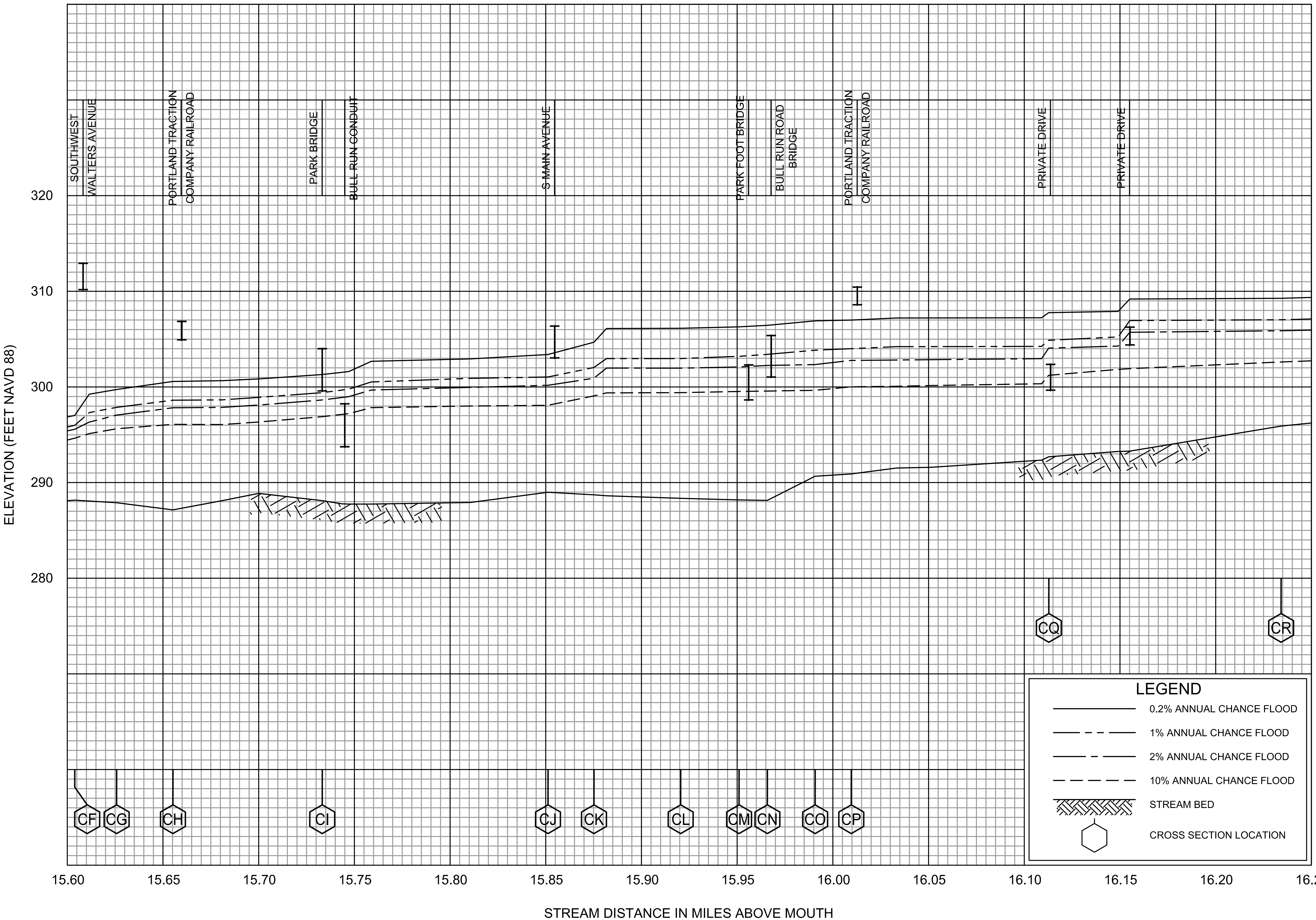
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

29P



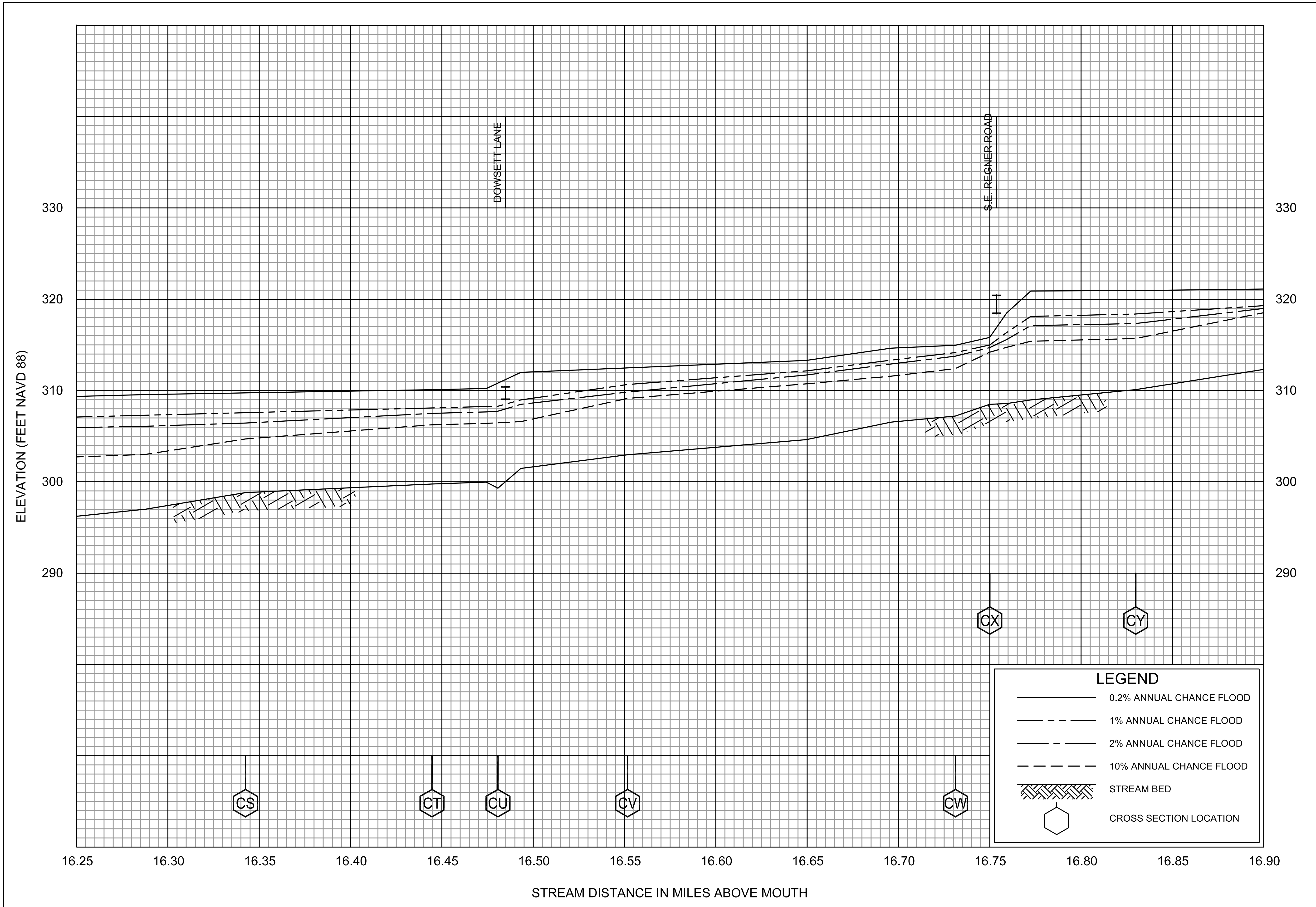
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

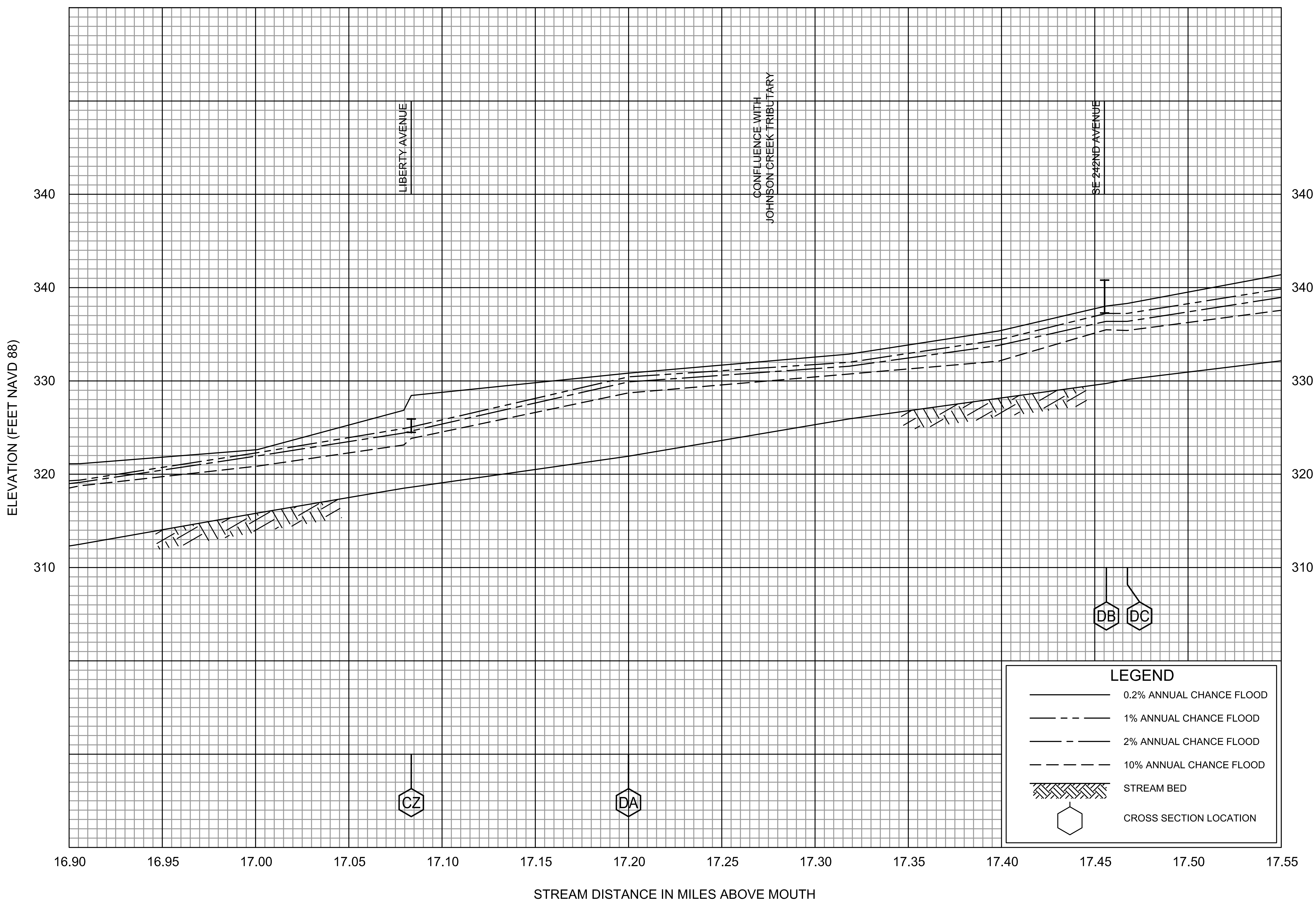
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

31P



FLOOD PROFILES

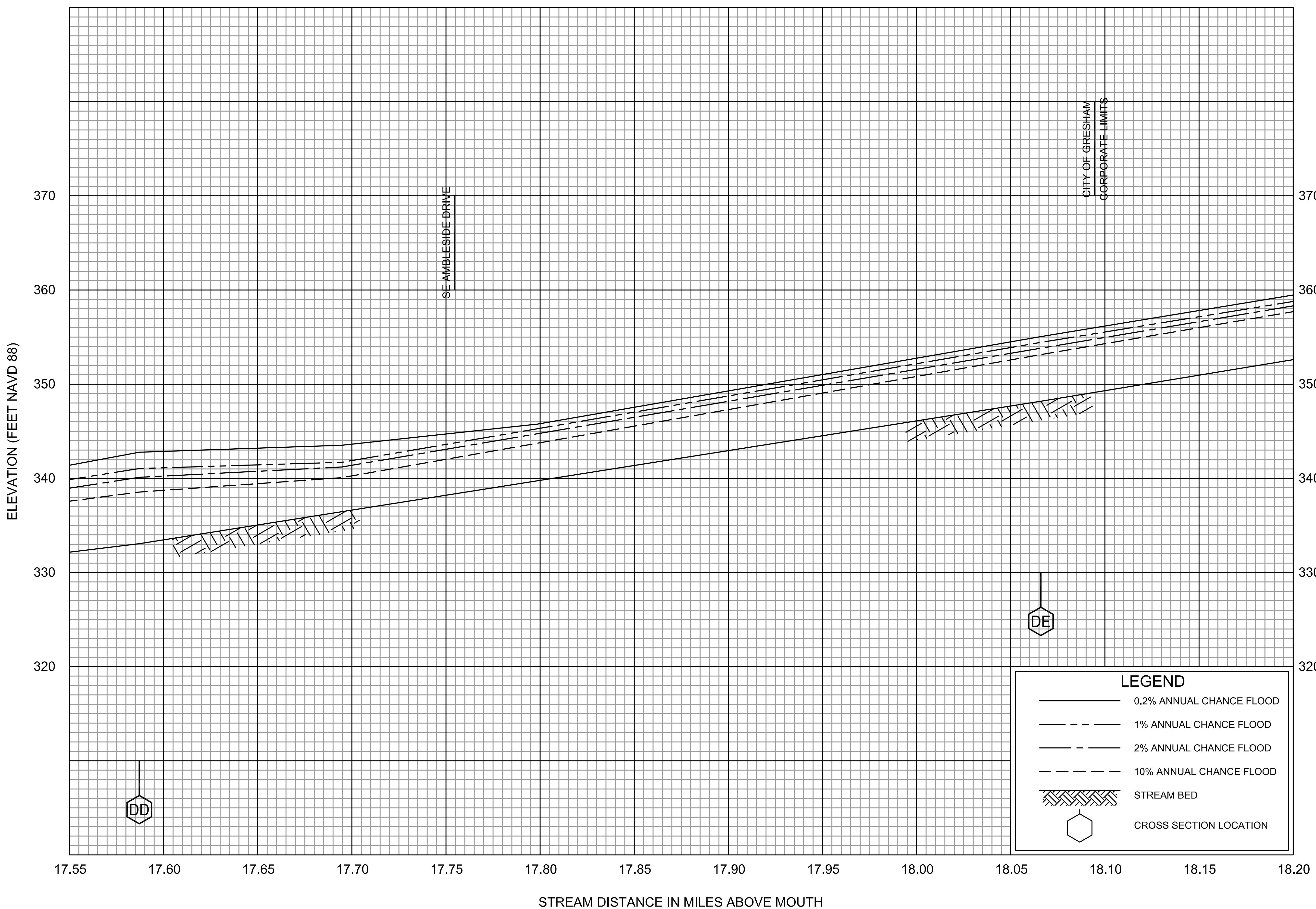
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

32P



FLOOD PROFILES

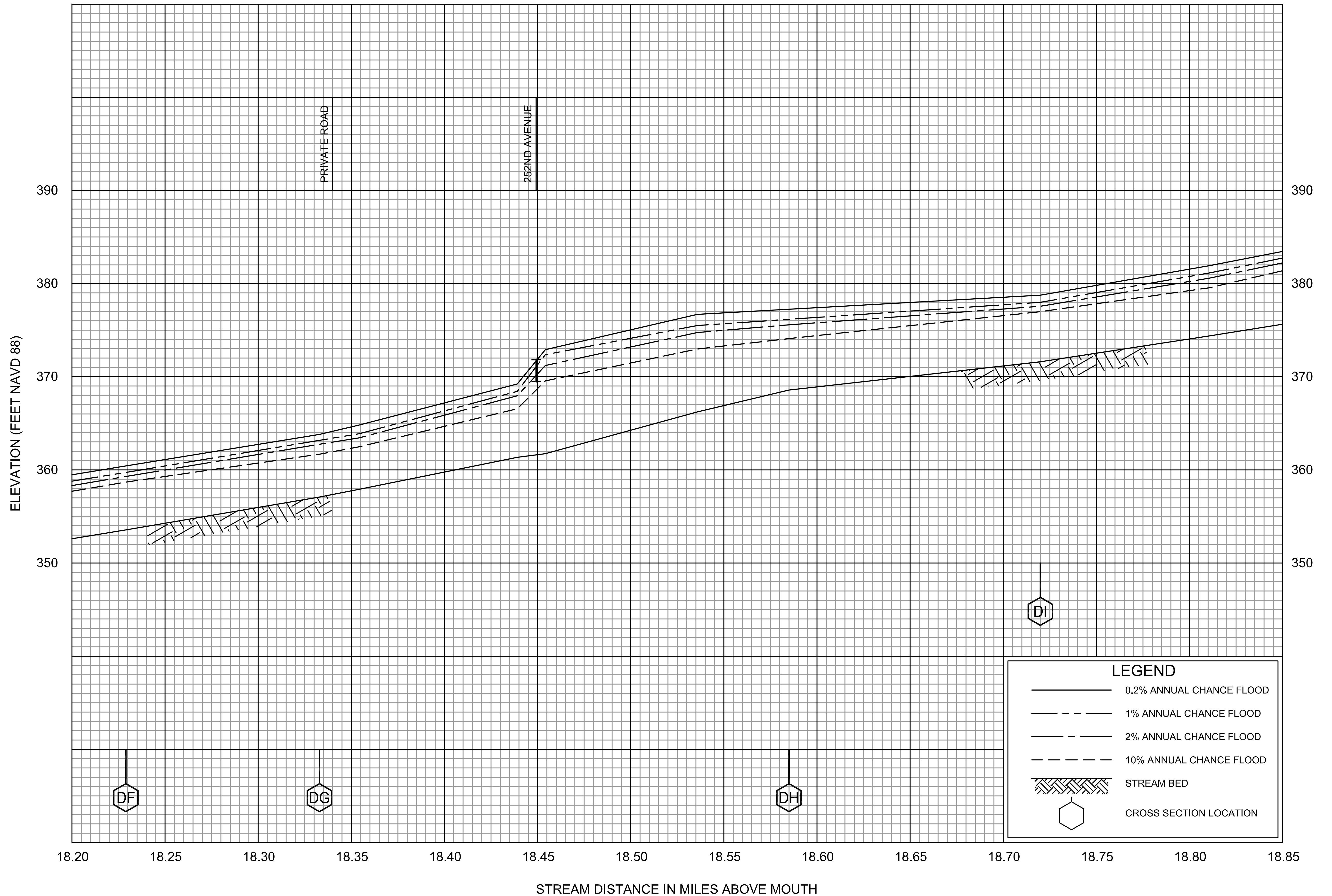
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

33P



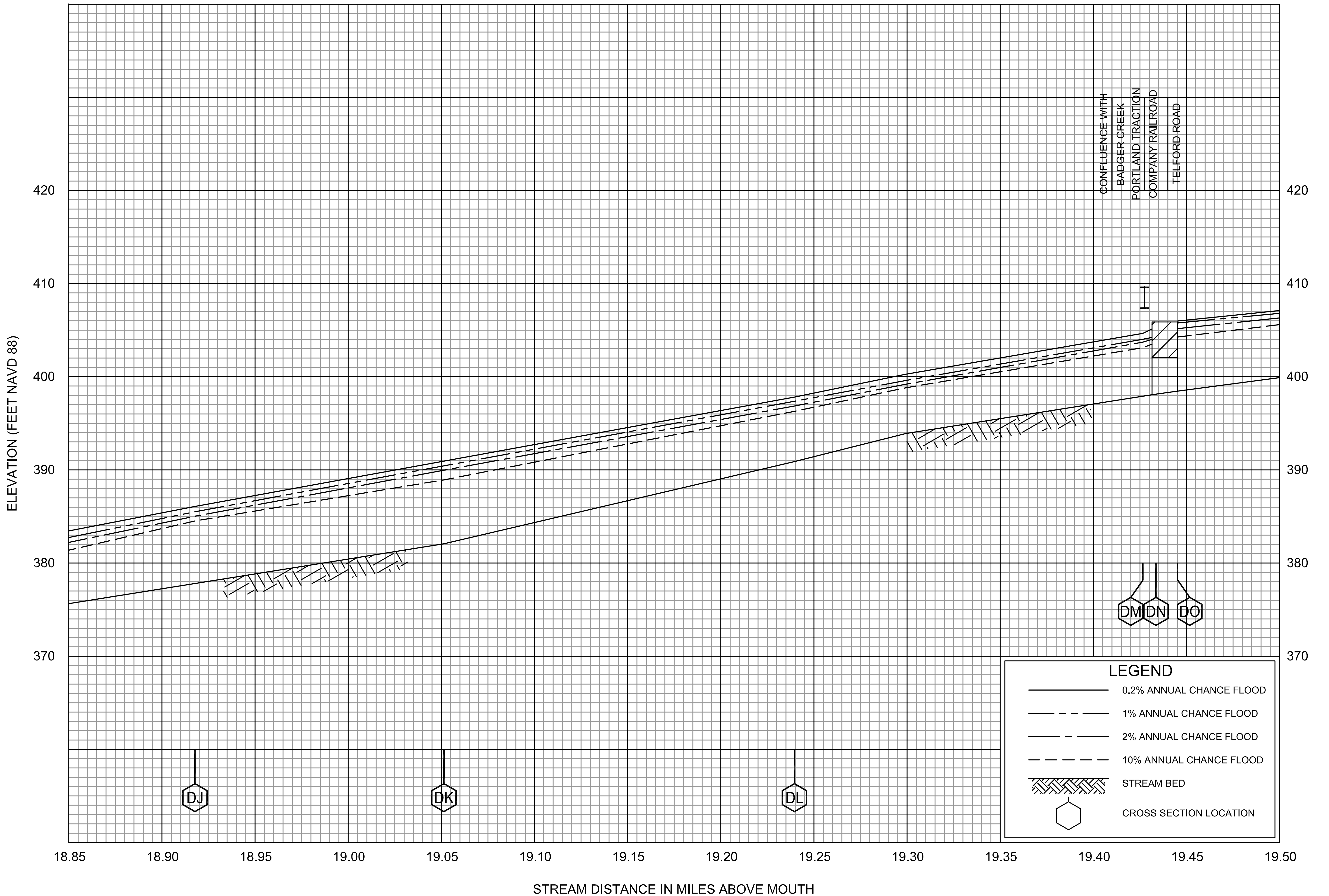
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

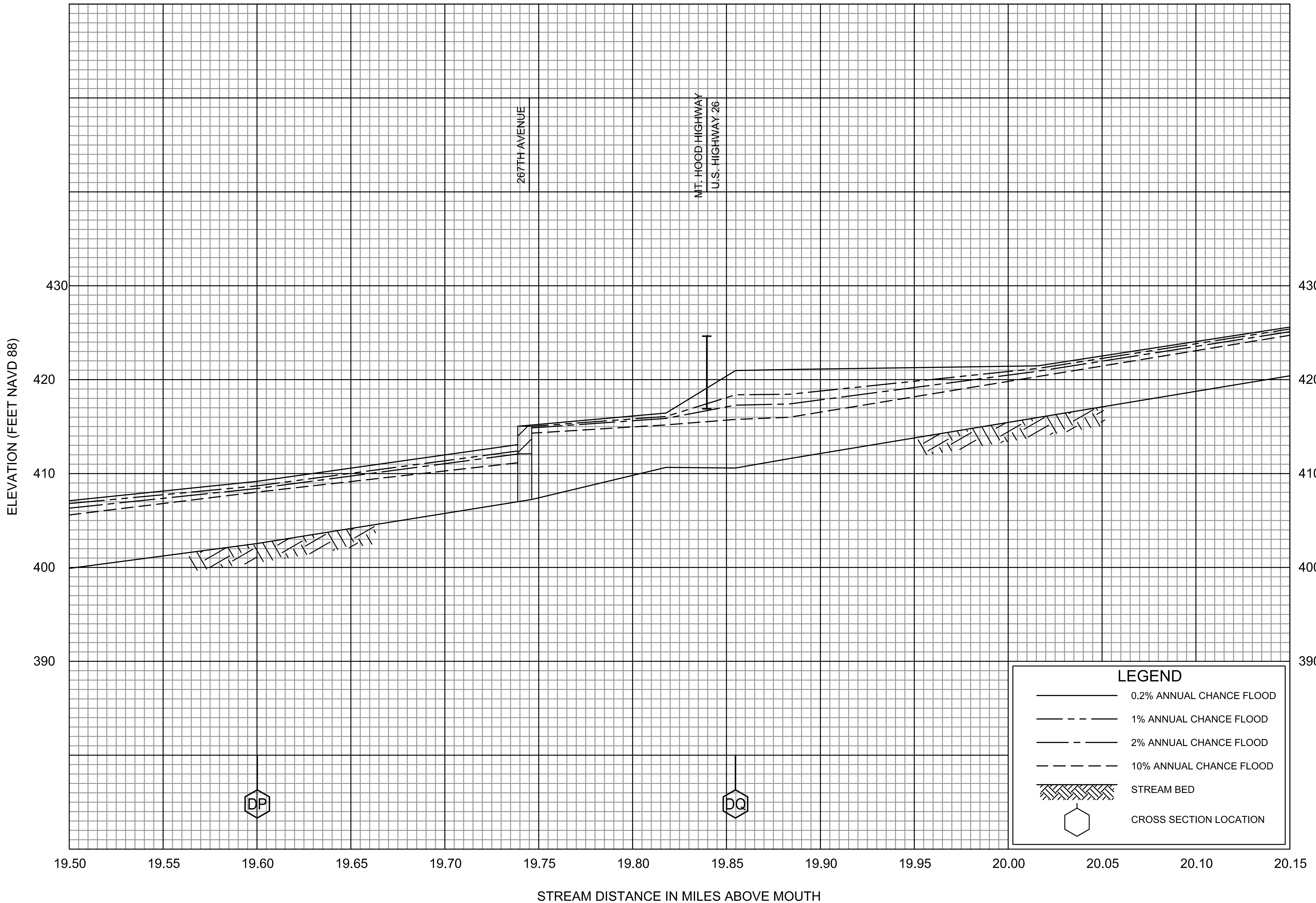
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

35P



FLOOD PROFILES

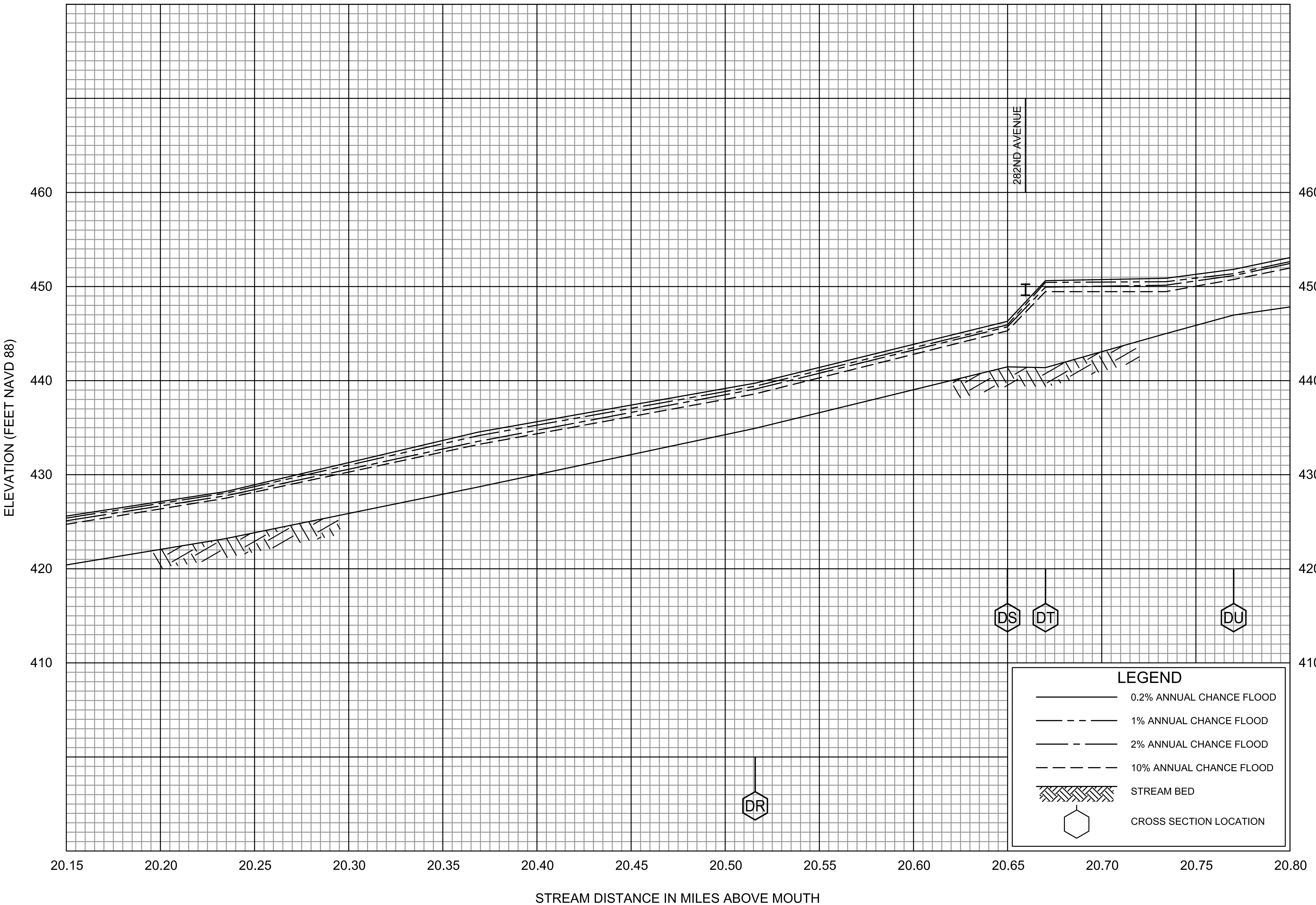
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

36P



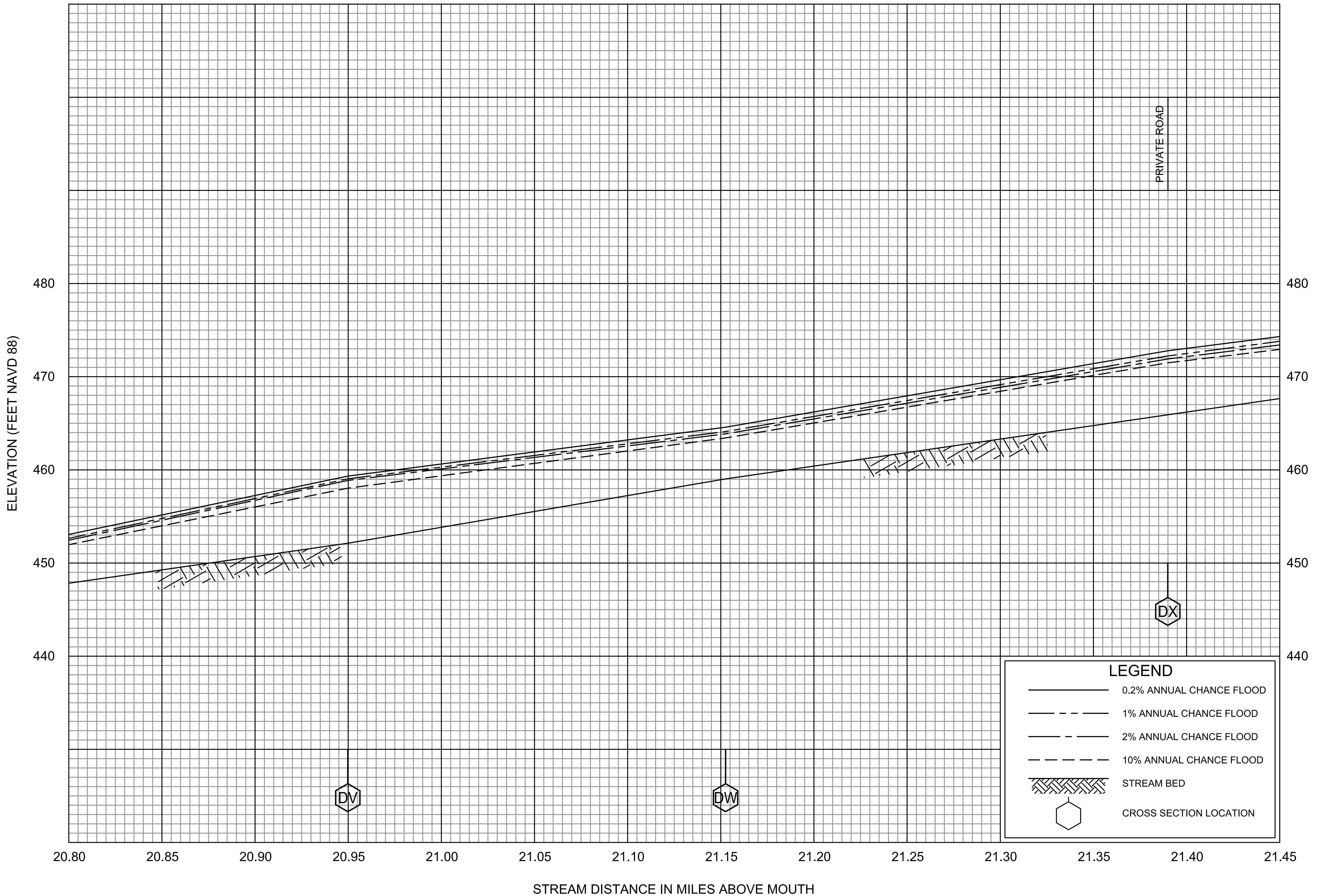
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



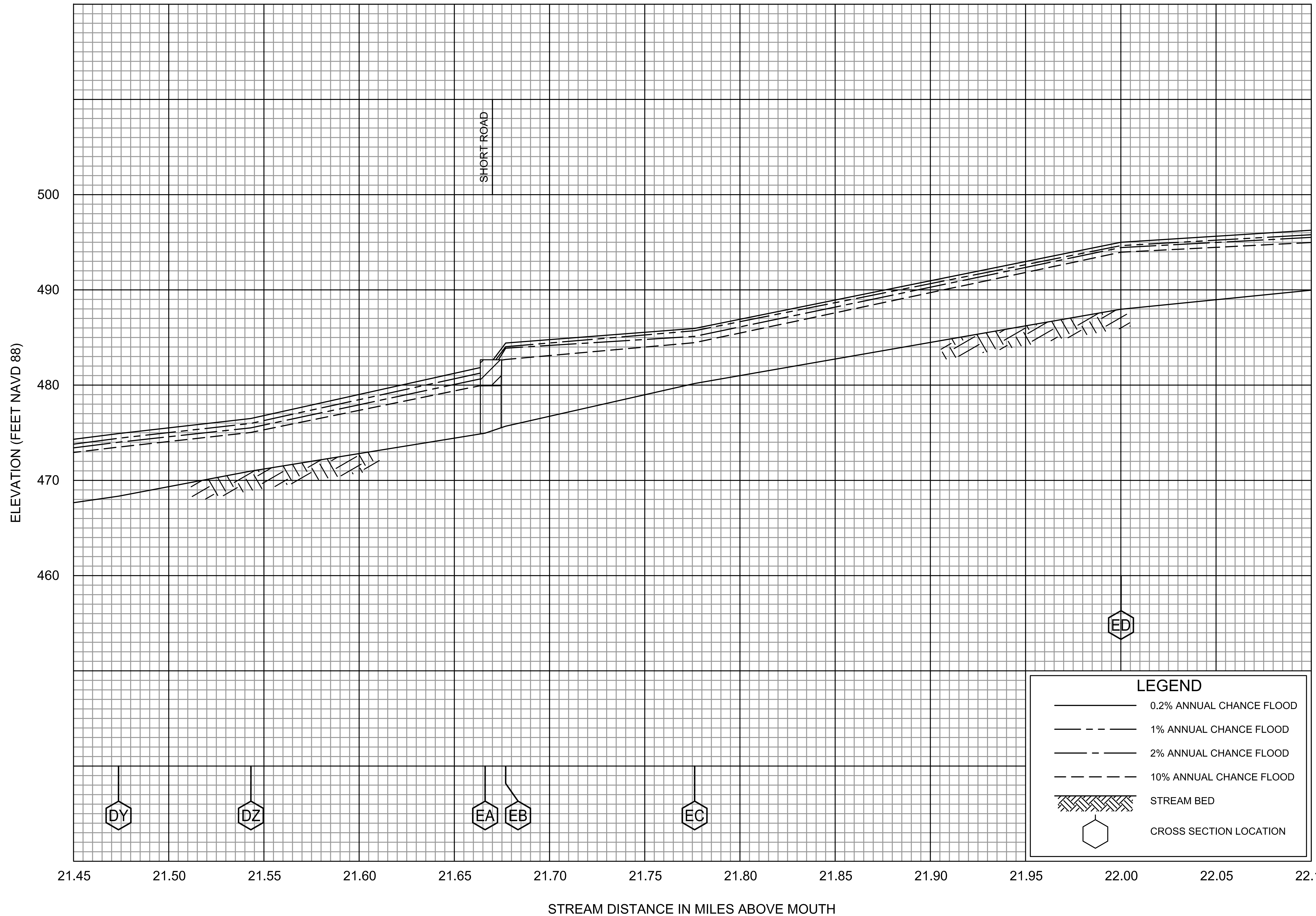
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



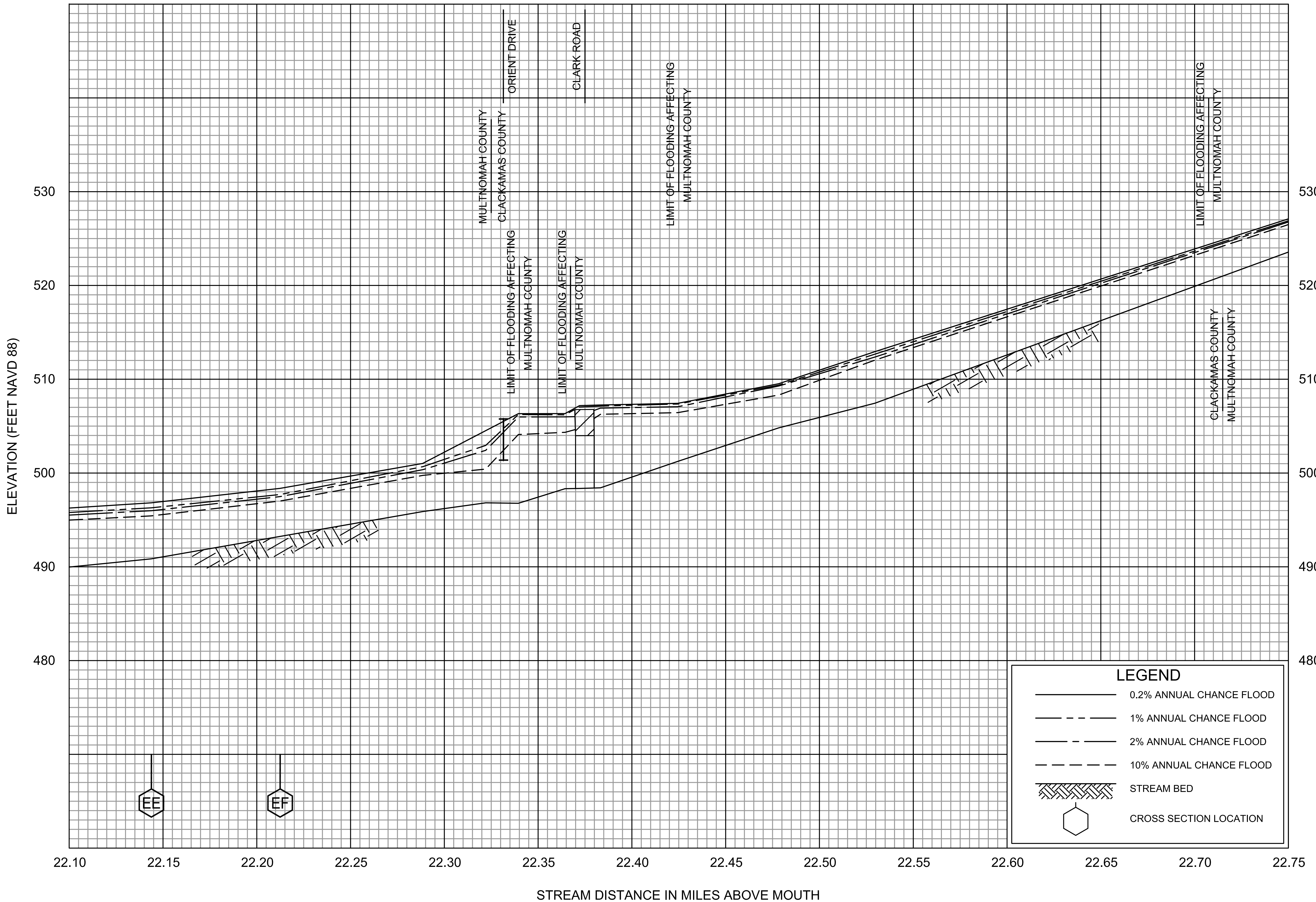
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



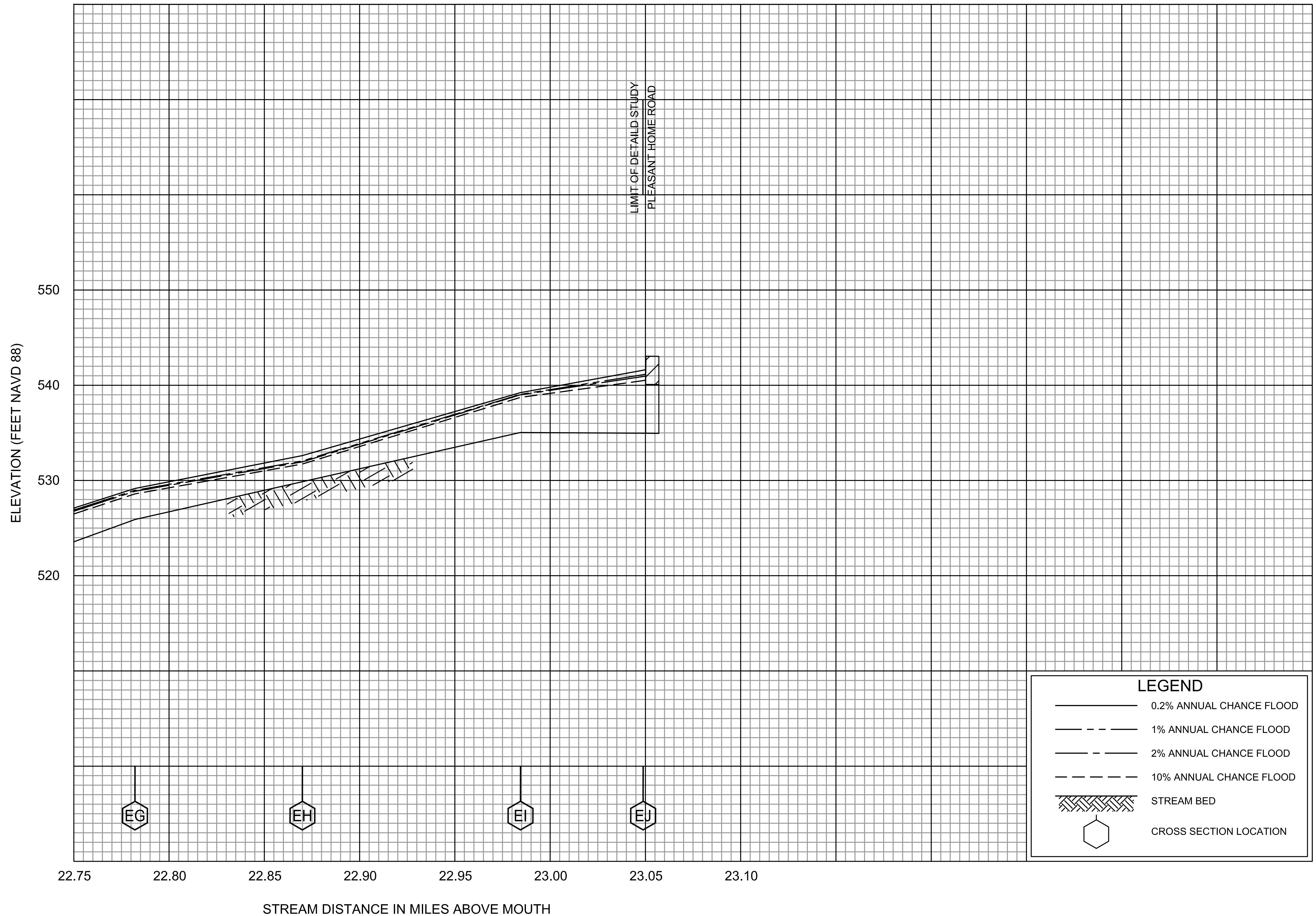
FLOOD PROFILES

JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

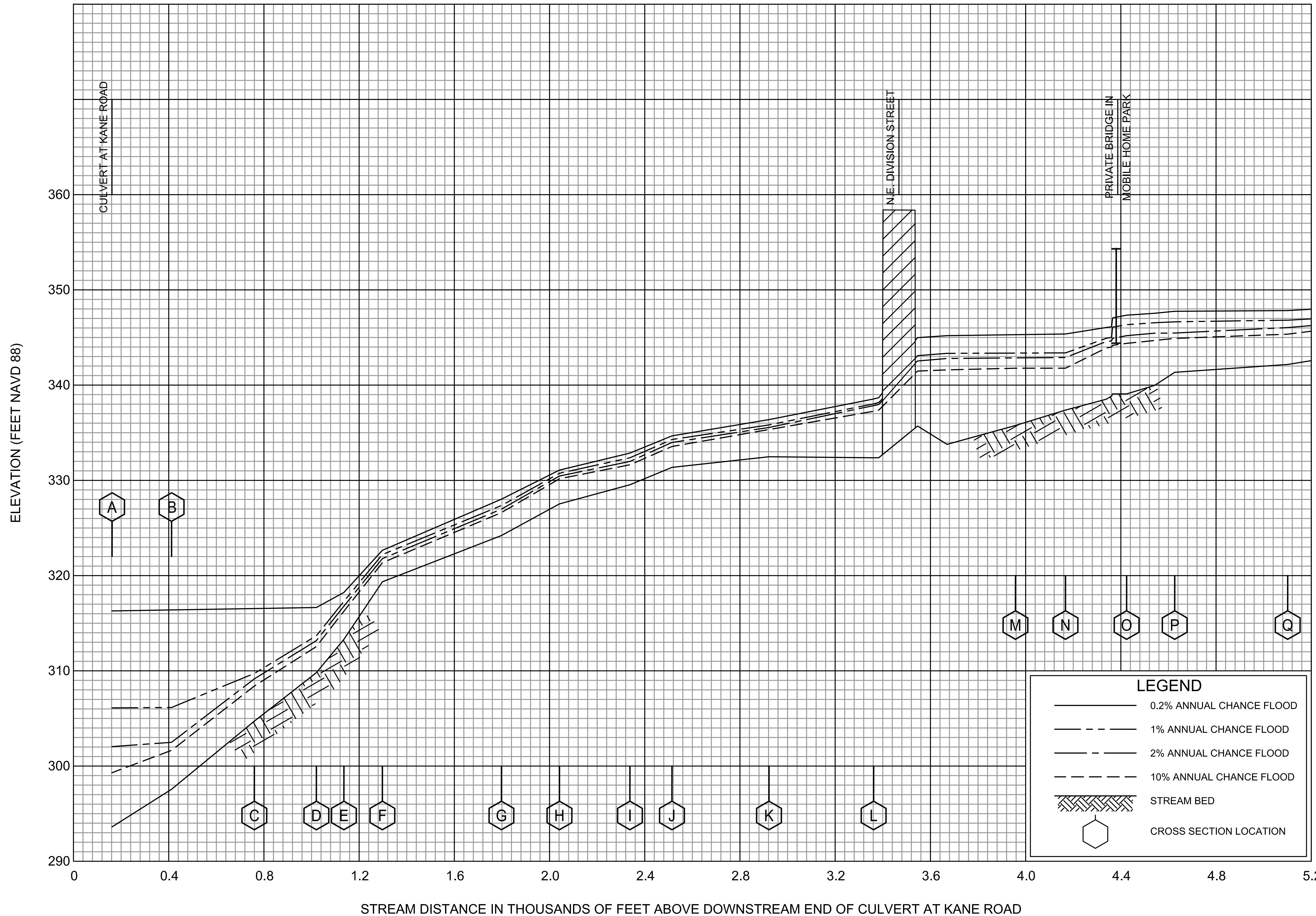
JOHNSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

41P



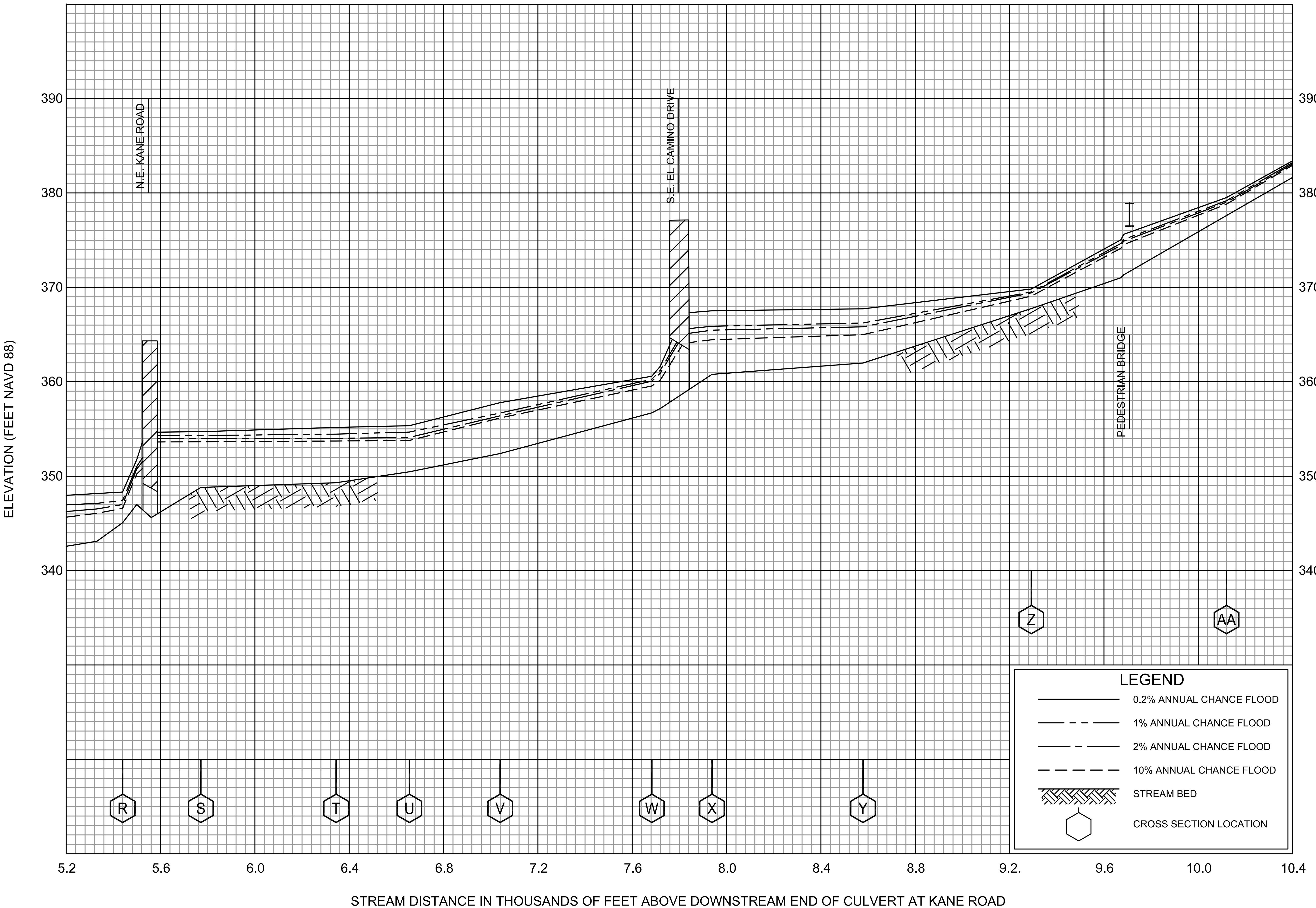
FLOOD PROFILES

KELLY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



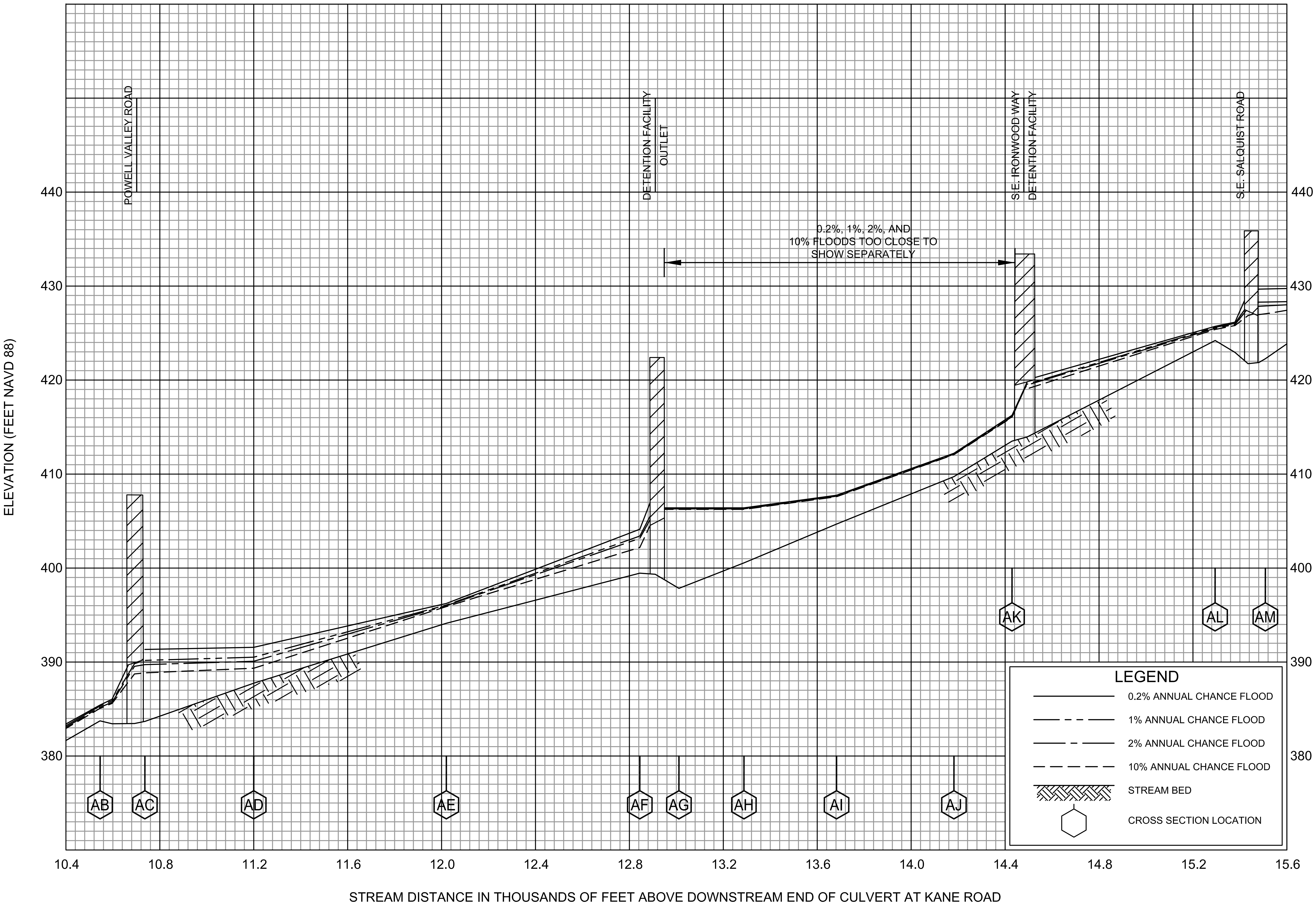
FLOOD PROFILES

KELLY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

KELLY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

FLOOD PROFILES

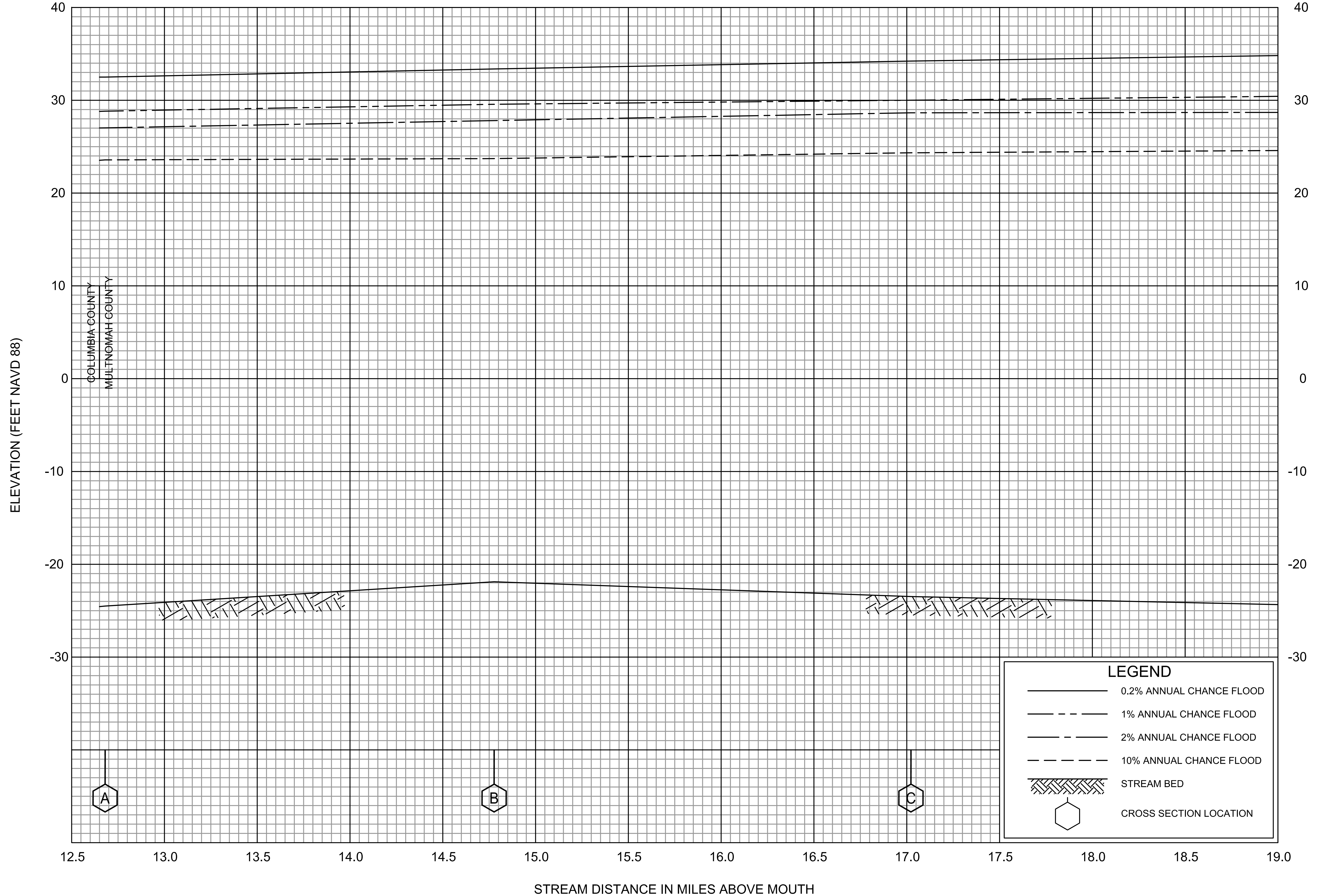
KELLY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

45P



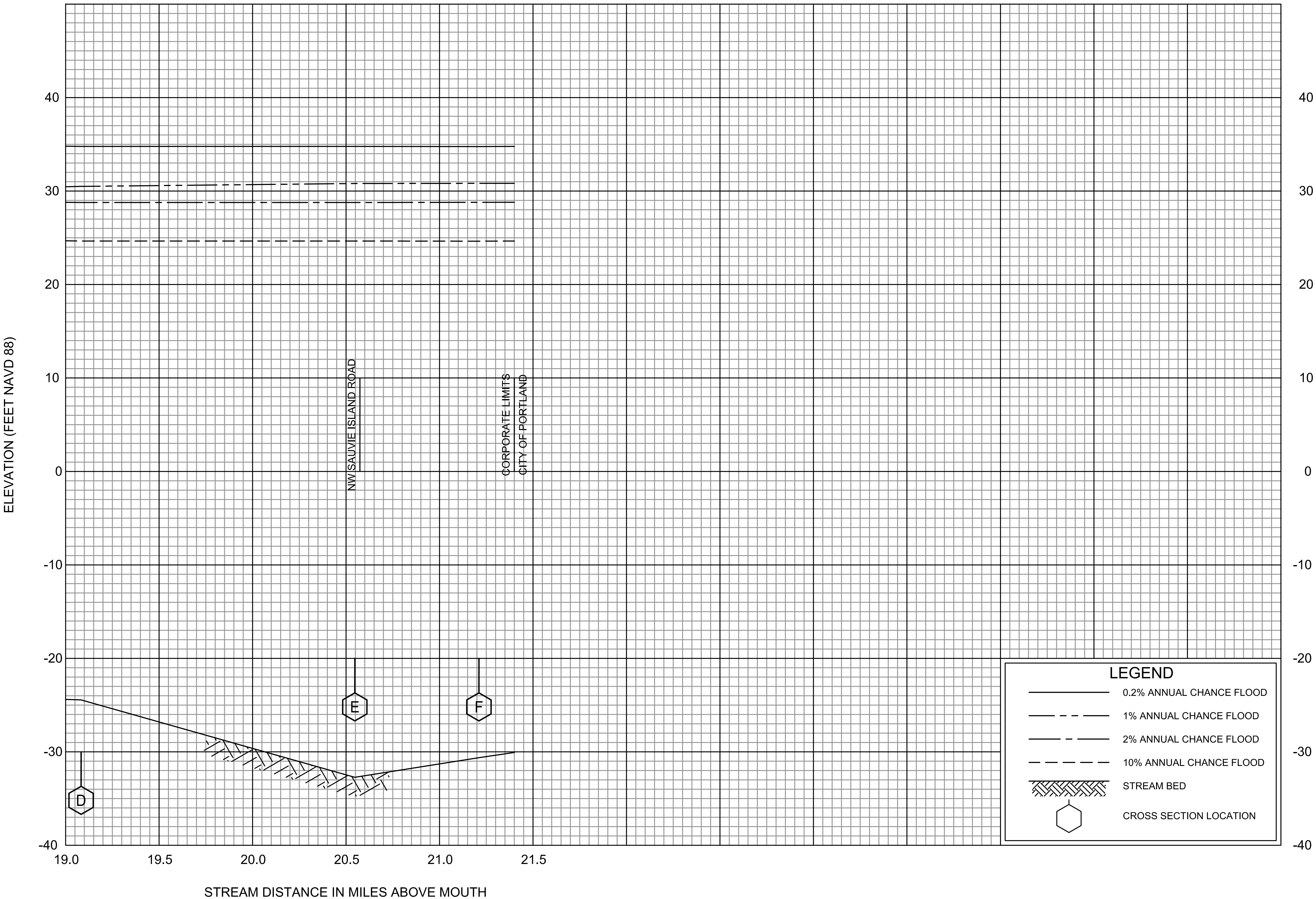
FLOOD PROFILES

MULTNOMAH CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



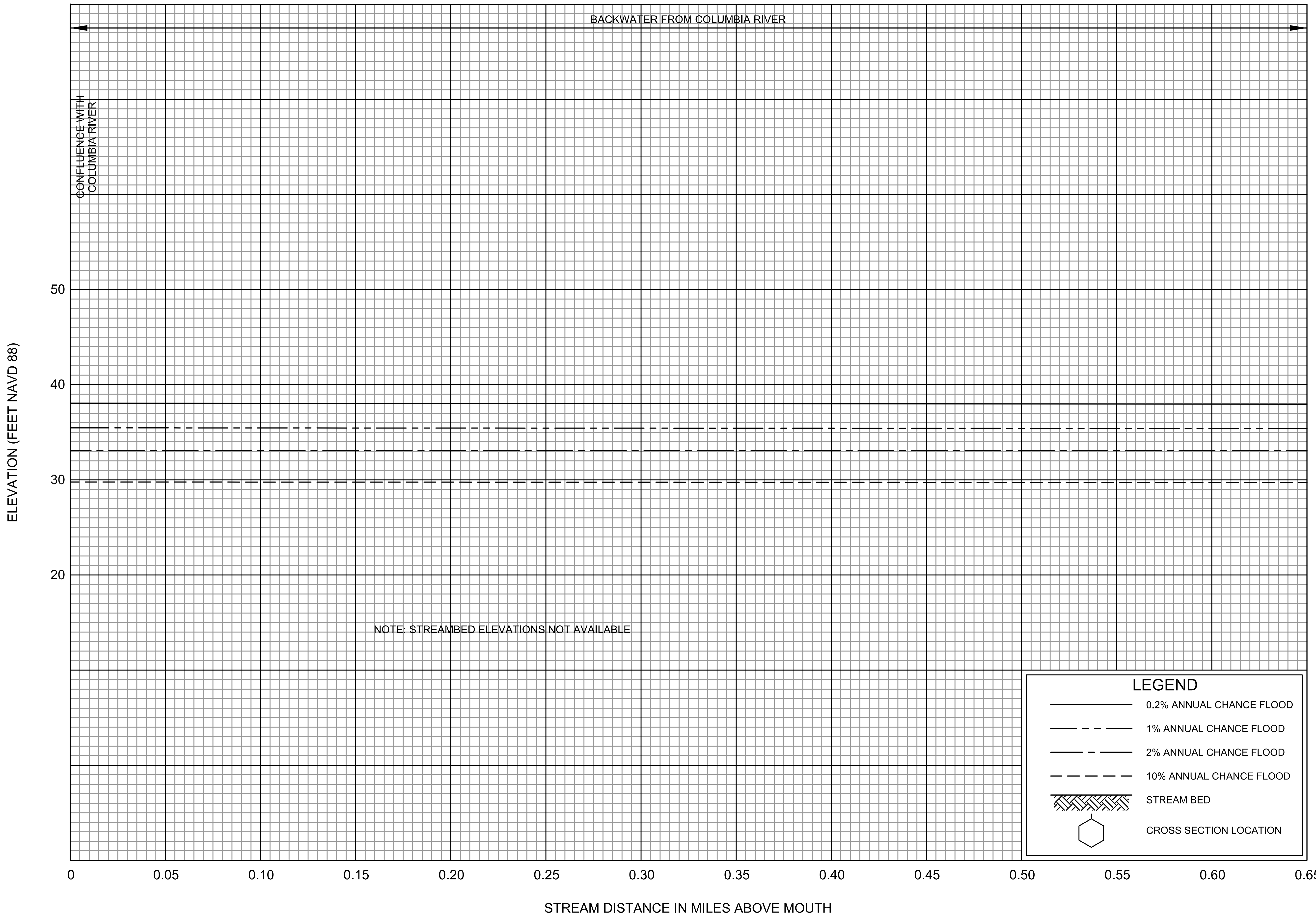
FLOOD PROFILES

MULTNOMAH CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



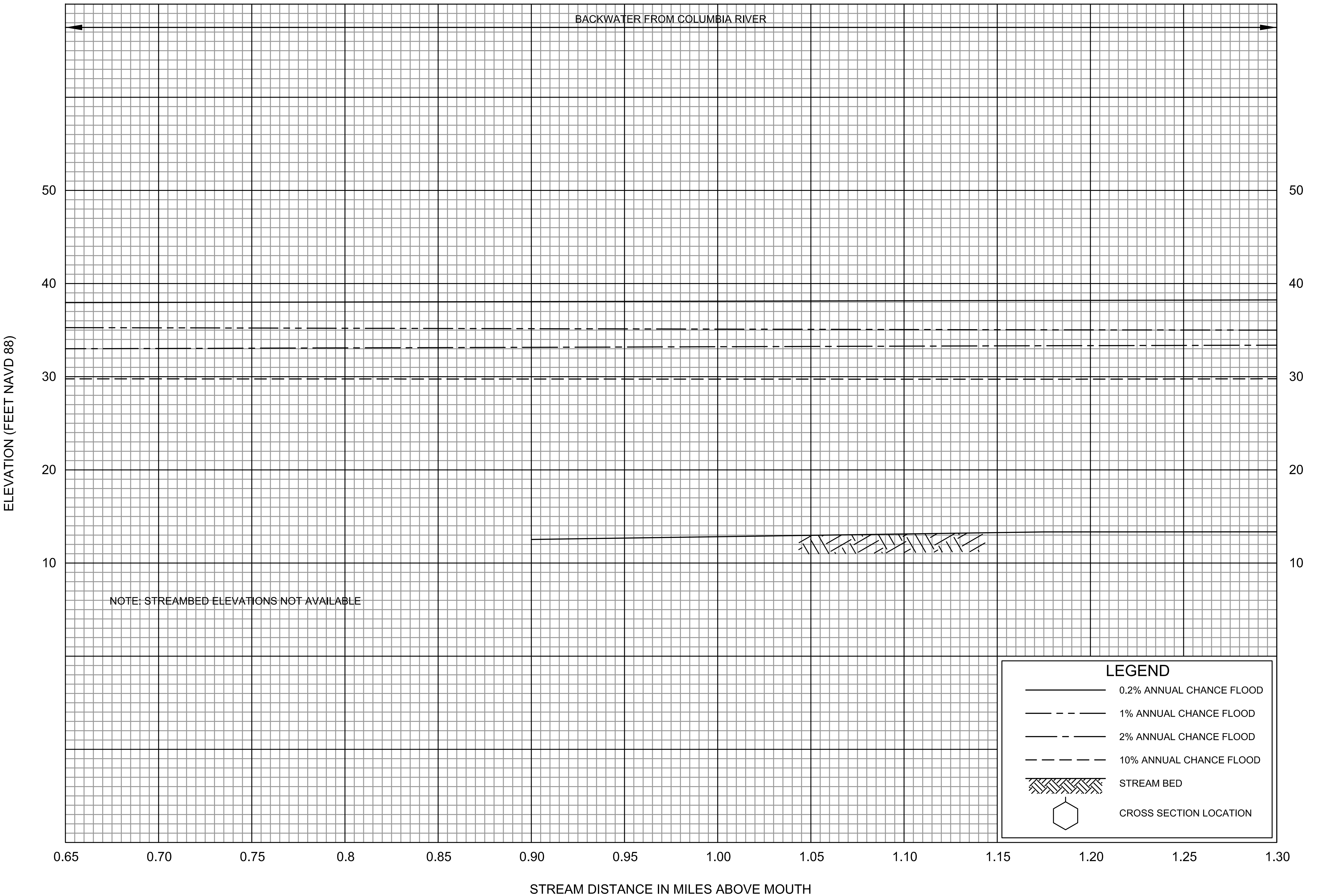
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

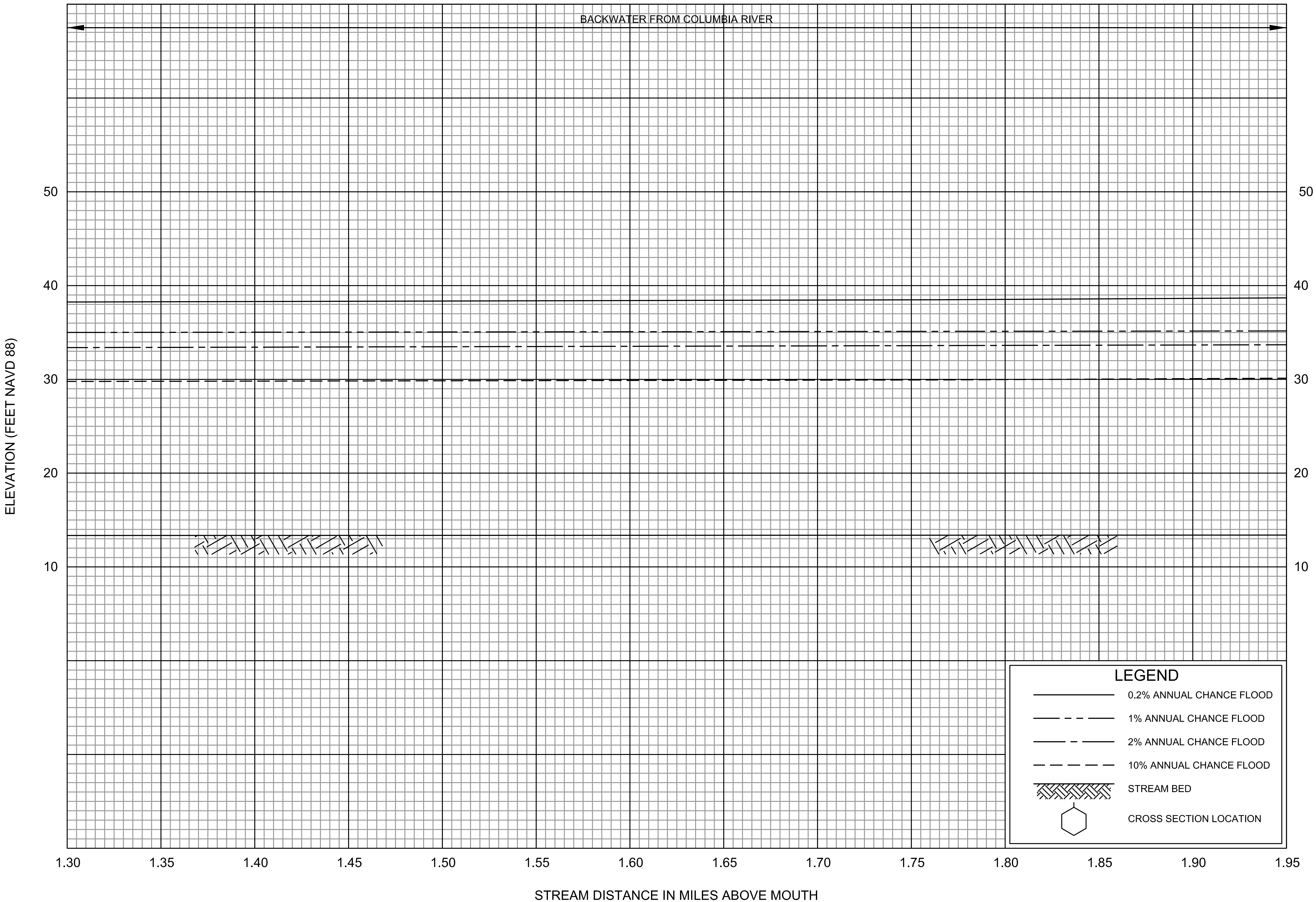
SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

49P



FLOOD PROFILES

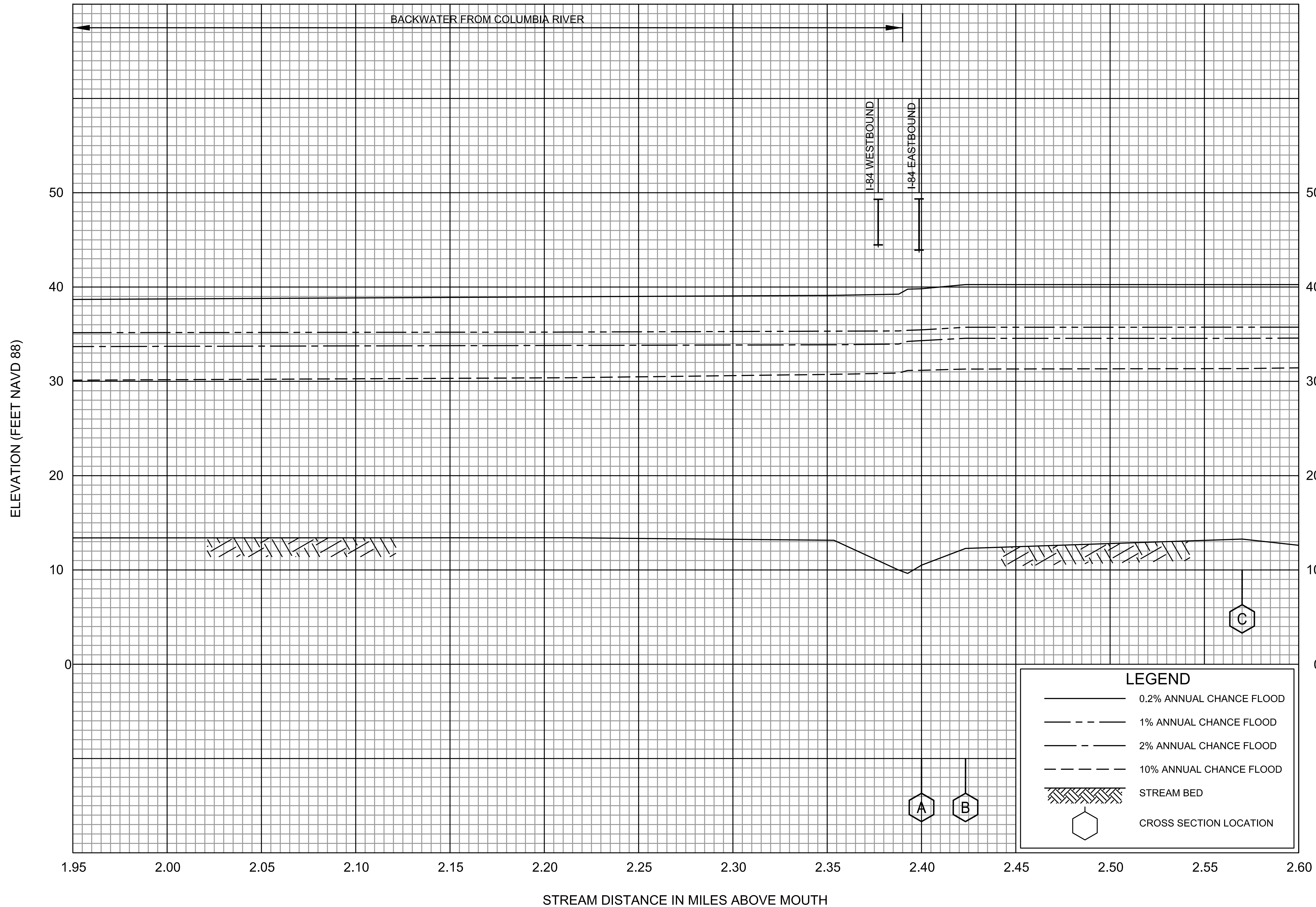
SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

50P



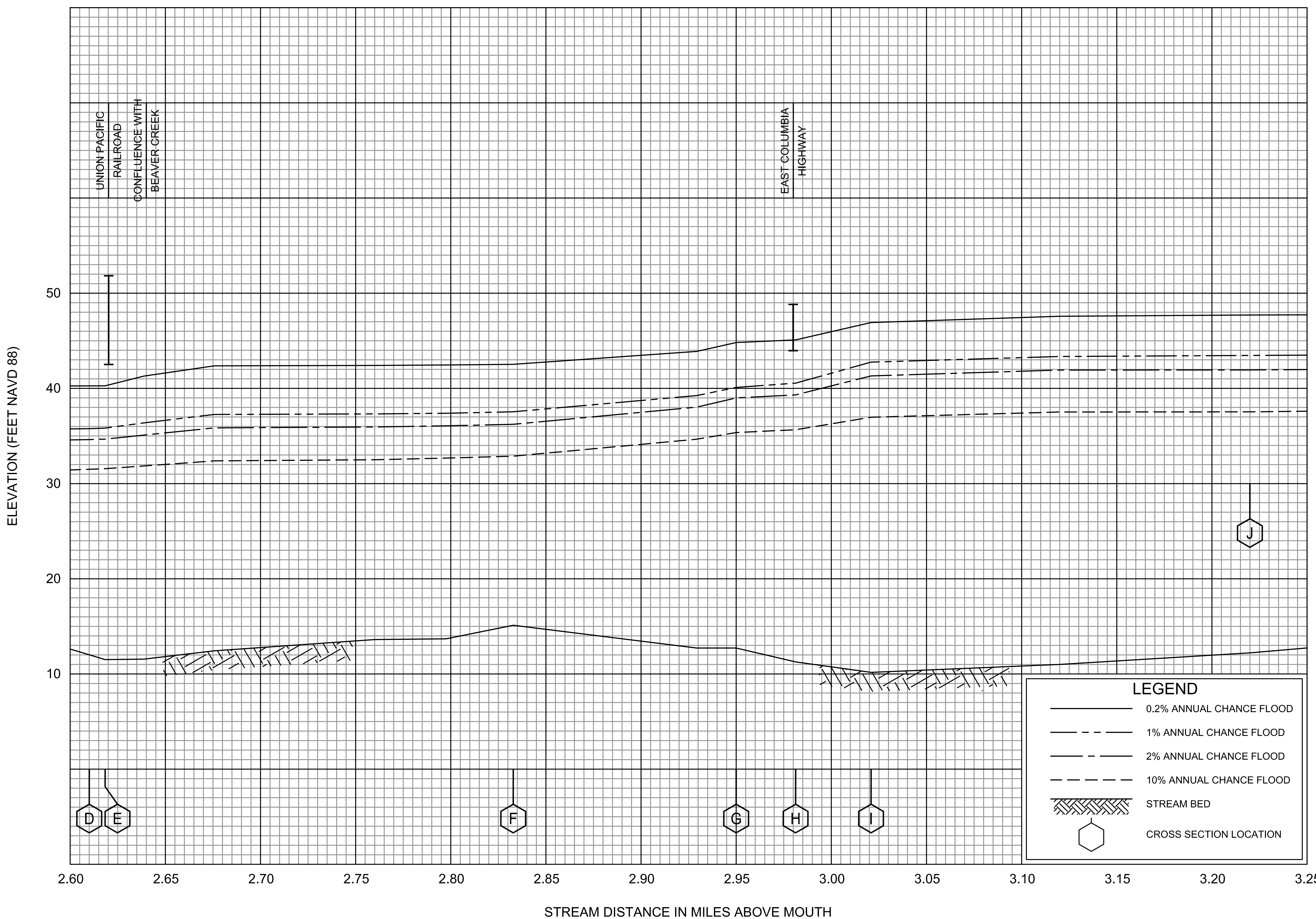
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

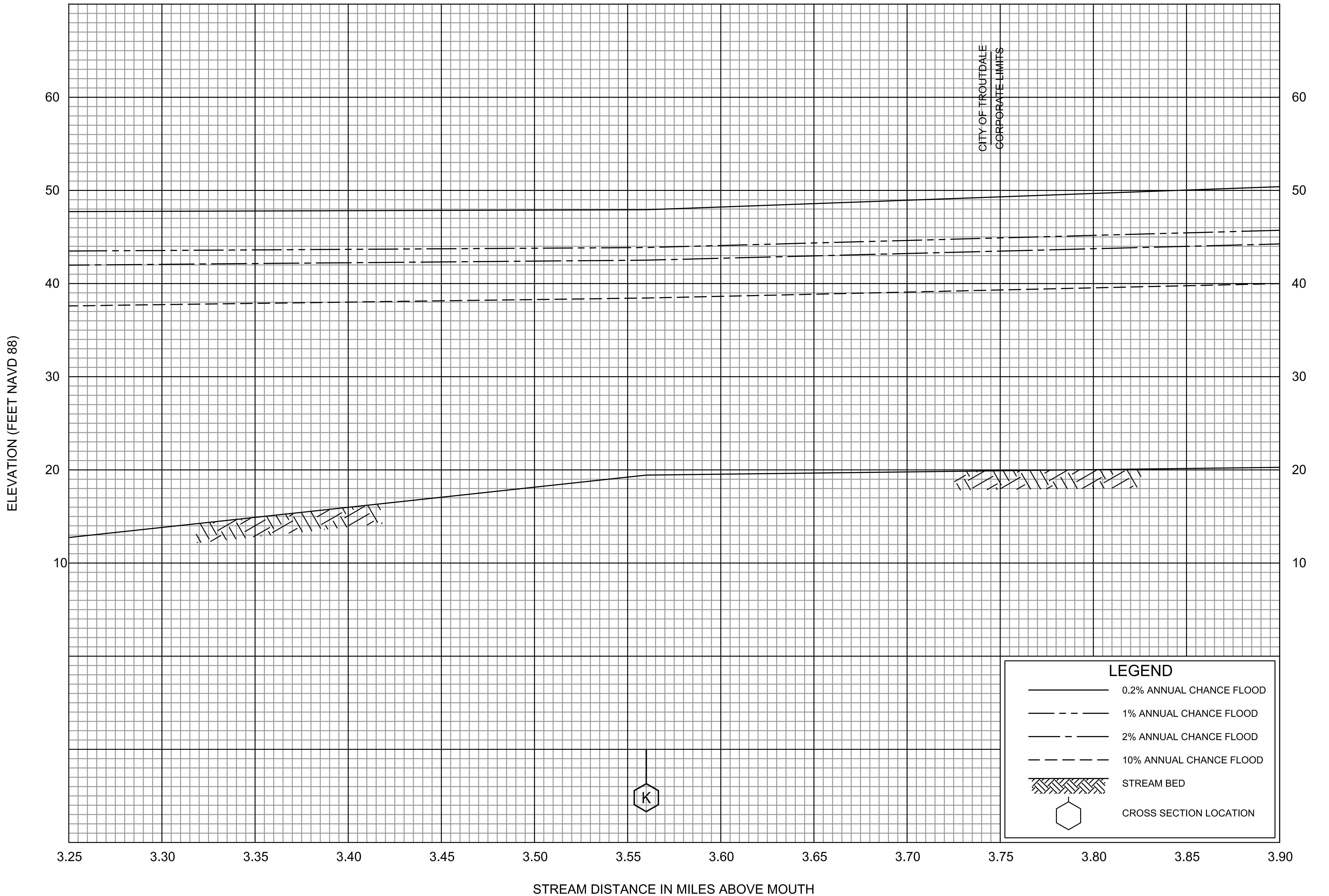
SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

52P



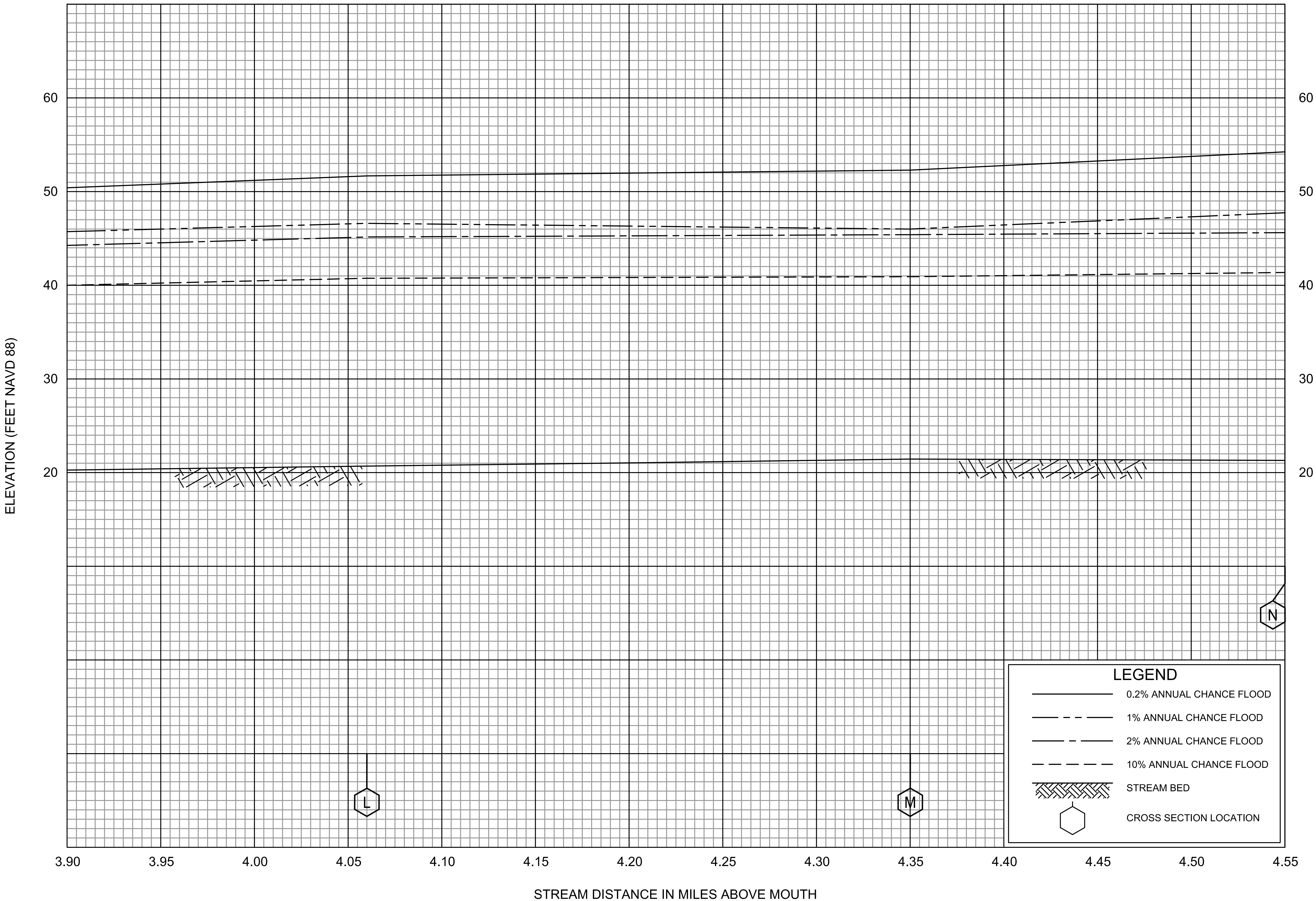
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



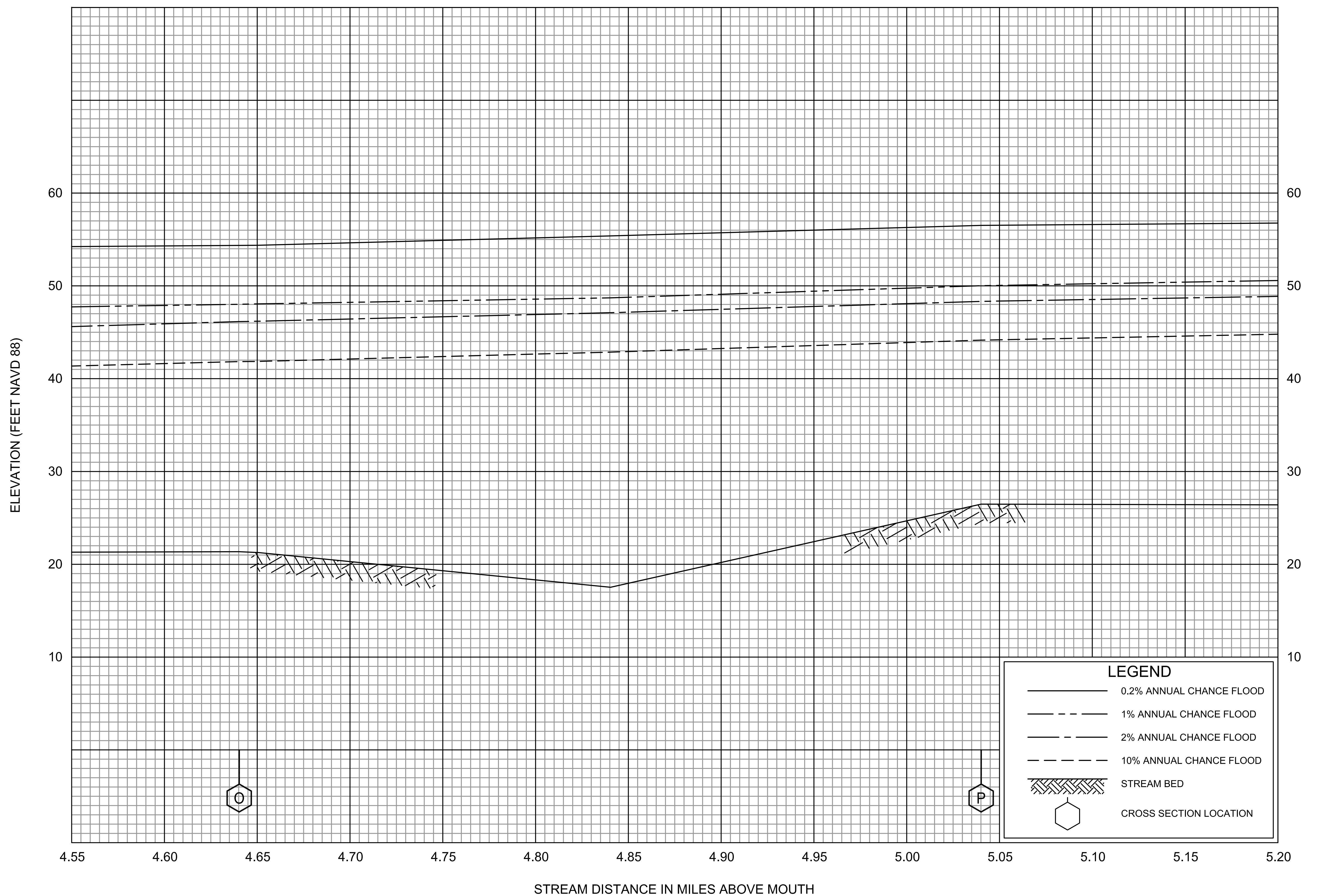
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



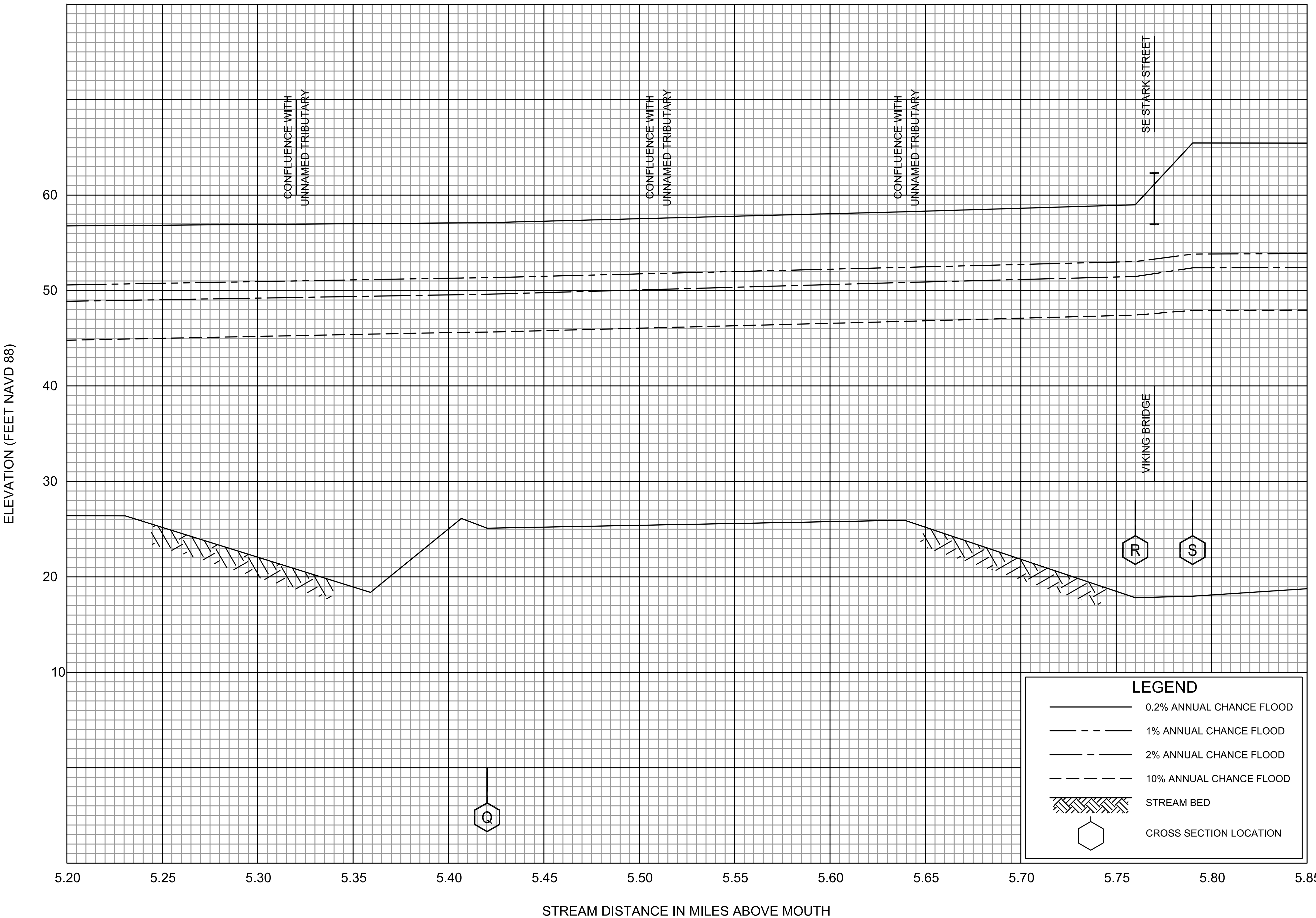
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



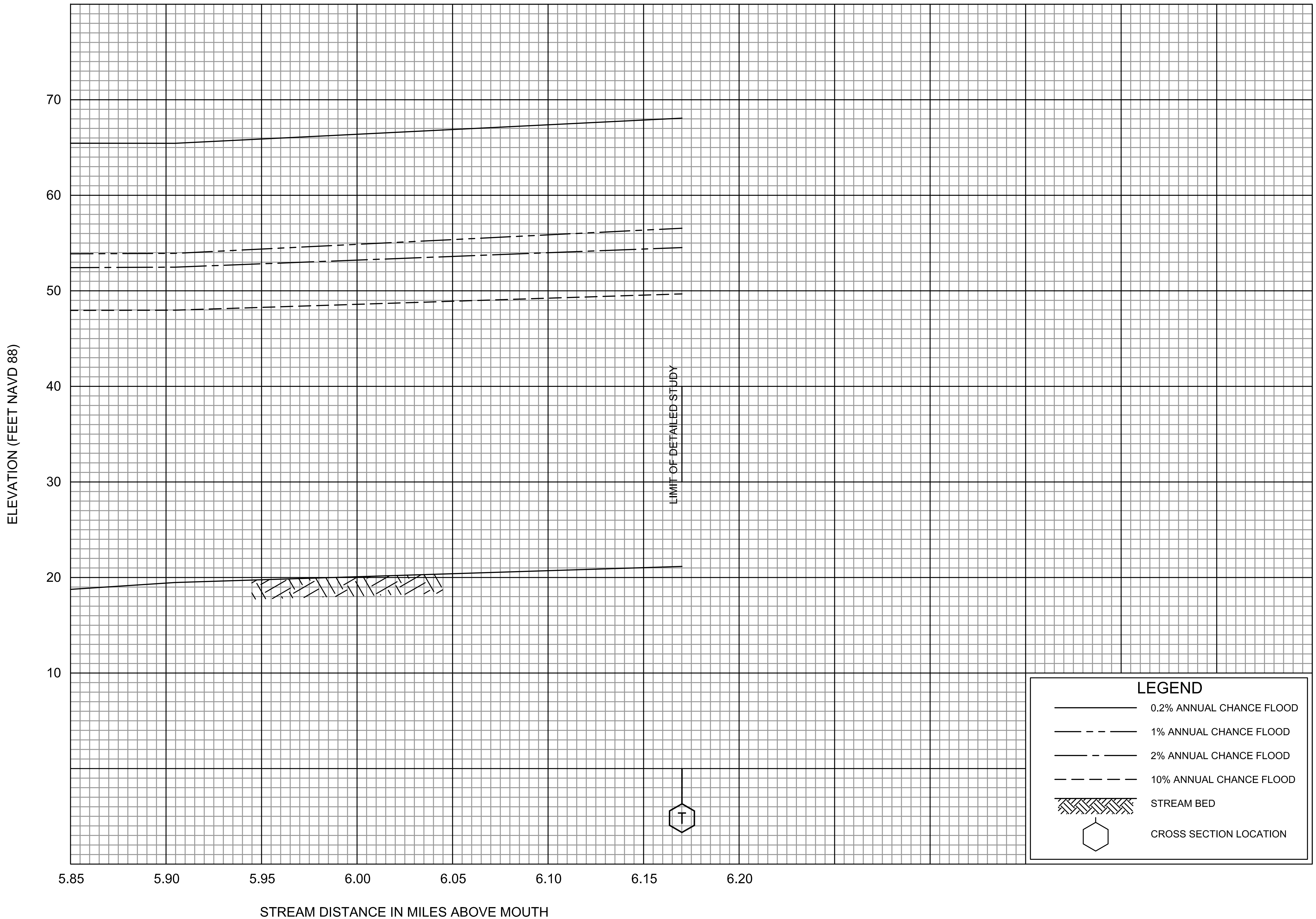
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

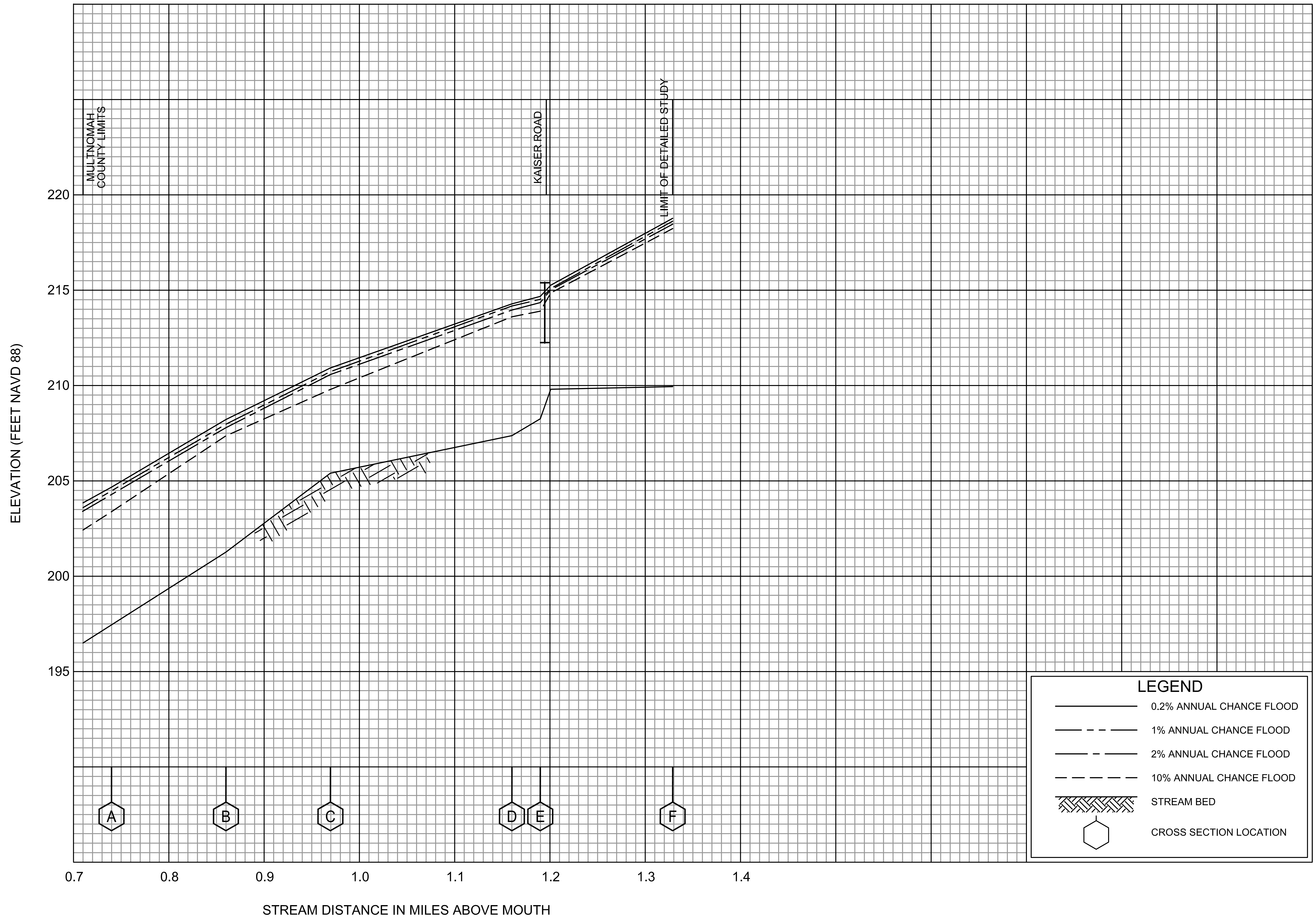
SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

57P



FLOOD PROFILES

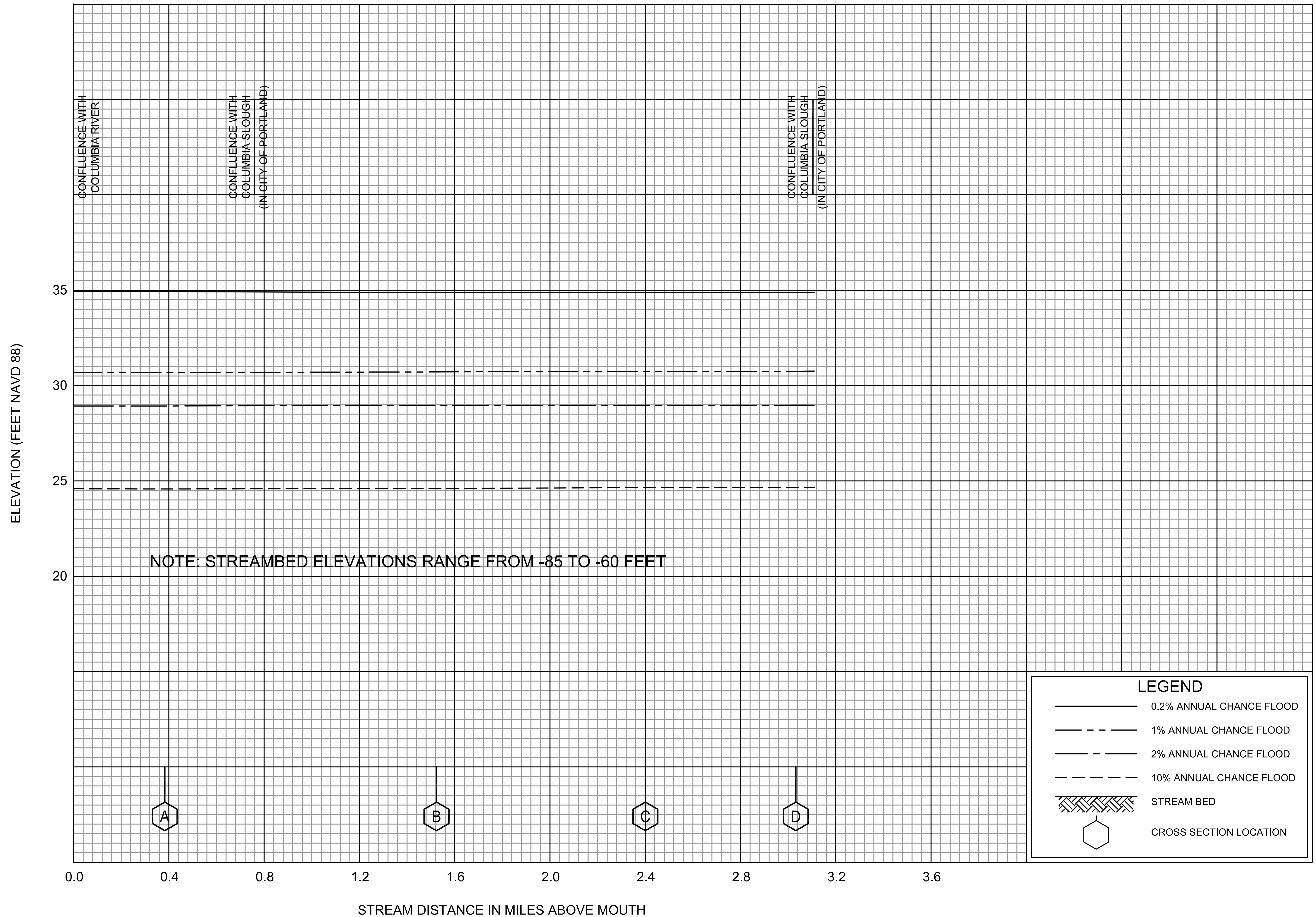
UNNAMED TRIBUTARY TO ROCK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS

58P



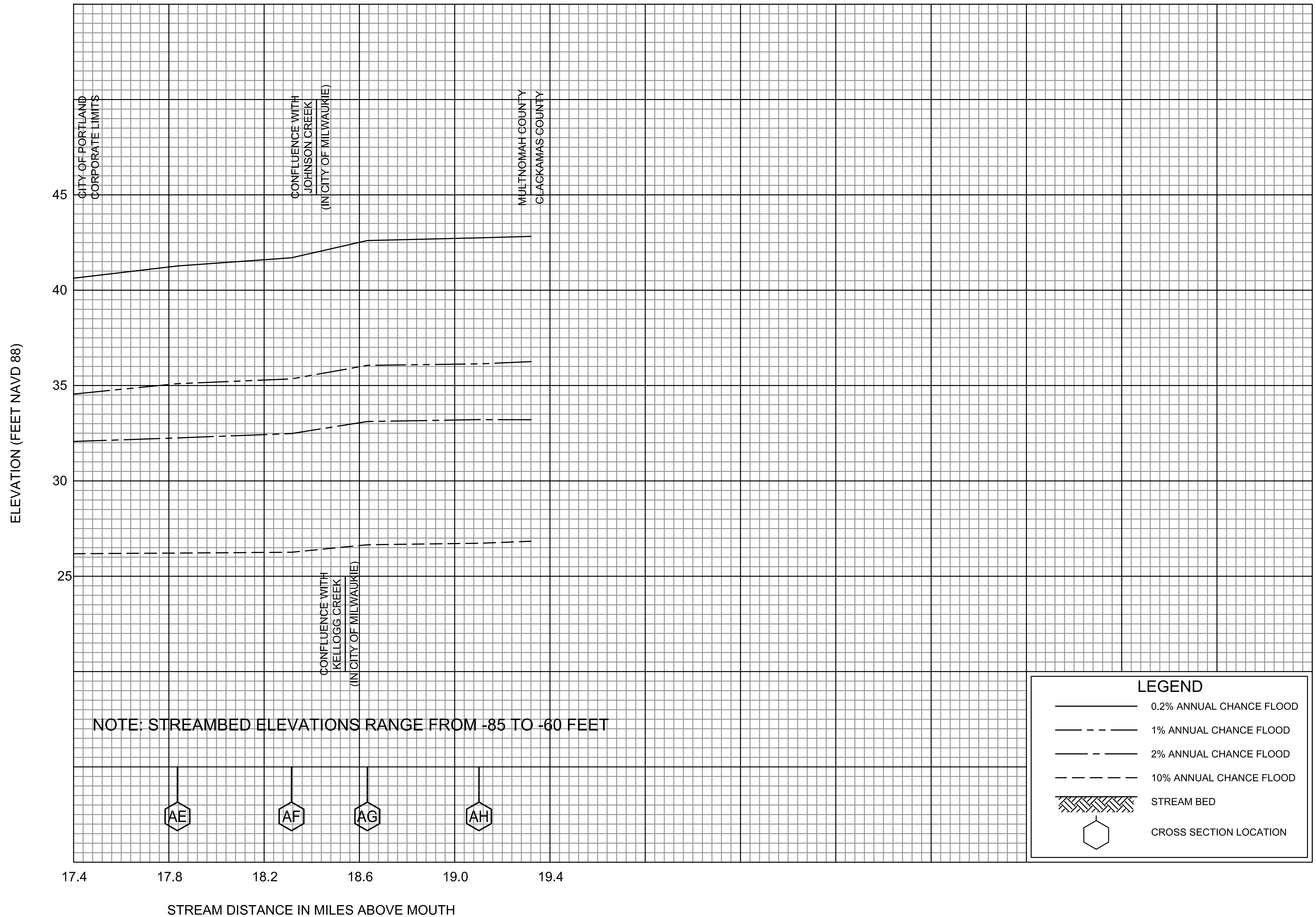
FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS



FLOOD PROFILES

WILLAMETTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MULTNOMAH CO, OR

AND INCORPORATED AREAS